Santa Clara Valley Water District

Biological and Surface Water Quality Monitoring Activities Evaluation Report

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Executive Summary

INTRODUCTION

The quantity and complexity of the biological and surface water quality monitoring conducted by the Santa Clara Valley Water District (District) is increasing rapidly. This trend will continue for the foreseeable future. The new monitoring requirements result from the District's amended mission, the Clean Safe Creeks and Natural Flood Protection authorization, regulatory permits for flood management projects, more stringently enforced environmental regulations, and settlements of legal and regulatory challenges to the District's operations.

The Monitoring Activities Evaluation Project (MAEP), financed through the General Manager's Performance, Effectiveness, and Accountability Program (PEAP), aims to help the District prepare for the increase in monitoring activities by making those efforts more effective and efficient.

The MAEP found that District projects generate considerable amounts of environmental data; however, the absence of an overall program design and the lack of systems or capacity to synthesize, interpret, and report data often prevent the District from using this data to make management decisions. The way that monitoring activities are organized impedes needed improvements in project quality assurance/quality control and data management.

The MAEP considered three alternatives for improving the organization of monitoring activities and described a 3-part strategy for implementing the recommended alternative. A detailed implementation plan is presented under a separate cover.

METHODS

Office of Countywide Watershed Management (OCWM) temporary staff, assisted by Stillwater Sciences, Inc., conducted the Monitoring Activities Evaluation Project (MAEP). This project team categorized and tabulated existing monitoring activities and projected the type and quantity of new monitoring requirements over the next 15 years. The project team also reviewed recent and pending actions by the Regional Water Quality Control Board (RWQCB) and other regulatory agencies and considered how these actions might result in new mandates for environmental monitoring. The team also analyzed trends in the scientific methodology of environmental monitoring, including measurement of ecosystem health and the use of adaptive management and stakeholder processes to set (and continuously update) watershed monitoring objectives and methods.

The project team independently investigated and evaluated the District's current organizational framework for implementing monitoring activities. To obtain the opinions of those most familiar with District biological and surface water quality monitoring, OCWM staff facilitated a "strengths, weaknesses, opportunities, and threats" (SWOT) session with a cross-section of District project managers, environmental scientists, and other staff.

The project team compared the District's situation with the recent experience of other environmental monitoring programs with which the District collaborates: the Santa Clara Valley Urban Runoff Program, the Bay Area Stormwater Management Agencies Association, and the RWQCB's Regional Monitoring Program for Trace Substances. The project team consulted guides and reports on the design of environmental monitoring programs.

FINDINGS

Chapters III and IV of this report describe in details the wide range of factors that we anticipate will determine the type and quantity of District monitoring activities over the next 15 years. To summarize, the most significant findings of this review and evaluation project can be stated as follows:

Anticipated Growth of Monitoring Requirements

F-1. Based on the definitions and assumptions adopted in this review, fiscal year 2001-2002 and 2002-2003 costs attributable to various monitoring activities are estimated to be in the order of approximately \$2.5 million and \$3.4 million respectively (see section III.A).

F-2. A number of mitigation compliance monitoring activities are underway and many are expected to remain active for the foreseeable future. The District is also conducting a number of special studies and surveys not directly related to regulatory compliance. These are also expected to expand and continue well into the future (section III.A).

F-3. Not all historic mitigation and monitoring commitments are accounted for at this time. Recently launched efforts to identify these commitments are expected to also identify additional monitoring needs that the District will want to address over the next 5 to 10 years (section III.C.6.).

F-4. The District's environmental monitoring needs and requirements are expected to grow dramatically in the coming years in conjunction with the 15-year Capital Improvement Plan, the Multi-Year Stream Maintenance Program, stream stewardship programs, watershed management and water supply operations. Based on our projections, it is estimated that annual costs for monitoring activities at the District will grow to approximately \$23 million by fiscal year 2018 (section III.D).

F-5. Collaboration with external monitoring programs will continue to play a significant role in the conduct of monitoring activities throughout the District. Currently, the District's financial contribution to collaborative monitoring efforts is estimated to be approximately \$290,000. This already substantial commitment of resources is expected to grow in the coming years.

Management, Organization, and Effectiveness of District Monitoring Activities.

F-6. Current monitoring practices and frameworks are variously modified leftovers from prior District organizational structures. The units involved have adjusted previously recognized roles, responsibilities, and lines of communication for initiating and planning monitoring activities to reflect their own sense of what the most recent watershed centered re-organization implies with respect to monitoring projects.

F-7. The information required for this review and analysis project was spread among various operating units and much of it was difficult to obtain.

F-8. A framework to systematically and rigorously assess and track the effectiveness and efficiency of the individual and/or collective monitoring efforts does not currently exist. Effectiveness goals, objectives, criteria, and standards have not been articulated. More importantly, the project planning, budgeting, management, and tracking practices are highly variable, and current cost tracking procedures are not designed to capture and delineate monitoring-specific tasks and expenditures.

F-9. Qualitatively however, it is clear from our findings that the current management, organization, and conduct of ecological monitoring activities at the District cannot be characterized as fully effective because:

F-9.a. There is no current and unambiguous assessment of the degree to which on going monitoring activities effectively comply with all outstanding regulatory requirements.

F-9.b. Current activities are mostly project-specific, and results are generally not interpreted, synthesized, analyzed and presented in a format and within a context that provide meaningful answers to key questions that are integral to critical engineering and management decisions.

F-9.c. Historic or on-going monitoring efforts are not used effectively to improve the quality, applicability, and efficiency of newly negotiated monitoring requirements and agreements.

F-9.d. Monitoring activities are not being effectively applied towards the District's long-term strategic objective of becoming more self-regulating with respect to impacts on the water and environmental resources in its jurisdiction.

F-10. Efficiencies in the conduct of monitoring activities throughout the District also appear less than optimal.

F-10.a. Coordination and communication between projects, and with and between external collaborative monitoring initiatives, are minimal and highly variable. As a result, the level of efficiency and possible duplications, redundancies, and synergies within the overall monitoring program are not easily discernible by participants or by management.

F-10.b. The quality of the data collection is not programmatically and systematically assured, and the usefulness and utility of monitoring results are not maximized and ensured through uniform and consistent protocols for upfront project planning, budgeting, and scheduling, and for developing project-specific data quality objectives and data quality assurance plans.

Application to Needs Assessment

F-11. Our brief review of trends in environmental regulations shows that these regulations are evolving too rapidly to meaningfully project how these changes will affect District monitoring requirements even a year or two from now.

F-12. However, because of increasing focus on watershed sources of pollutants, and on the effects of pollutants in streams and reservoirs, it can be projected that these changes will profoundly affect District monitoring requirements.

F-13. New pollutants of concern, new knowledge of pollutant sources, fate, and transport, and new regulatory approaches to investigating and controlling pollutants require that the District pay close attention to evolving regulations and regulatory activities.

F-14. Relevant new regulatory and scientific information is disseminated, and monitoring program designs are developed, within the context of regional monitoring collaboratives including SCVURPPP, SCBWMI, and the RMP, as well as project-specific stakeholder groups like the Mercury Council and the PCB TMDL stakeholder group. The District contributes financial support to some of these collaboratives, and staff participates in their various committees. However, the District lacks adequate staffing and organization to compile and analyze this information, make decisions, and respond timely. This leaves the District in a typical role of passive partner and source of funds to these collaboratives, rather than taking a leadership role.

F-15. Recent developments and apparent trends in legal and regulatory drivers that determine the District's future monitoring needs are favoring regional approaches and longer time horizons. Developments within the science, technology, and management of environmental monitoring are also tending towards more integrated analyses that require increasingly sophisticated conceptual and analytical tools.

F-16. Looking to the future, we see abundant indications that ecological monitoring activities at the District will continue to take on larger, more prominent, and highly complex roles in the normal operations and decision-making frameworks within the District.

CONCLUSIONS

Based on the above findings, the following are conclusions we made with respect to current and future monitoring activities at the District:

C-1. The investigation and analysis confirmed the scope and complexity of current monitoring activities. Projections confirm a forthcoming massive increase in monitoring commitments, driven by the multi-year Stream Maintenance Program, the Fisheries and Aquatic Habitat Collaborative Effort, implementation of the District's capital program, and other regulatory and programmatic commitments.

C-2. The District is insufficiently prepared to manage more biological and surface water quality monitoring. Its monitoring activities are managed project-by-project, in response to individual permit requirements or legal and regulatory settlements. There is inadequate coordination between projects and no mechanism to insure uniform quality assurance or data standards among projects.

C-3. The District lacks capacity to integrate the results of its many monitoring projects and to synthesize, interpret, and report data across projects. Despite the large quantity of data collected, District management often lacks the information and understanding it needs to make decisions about managing natural resources within its jurisdiction.

C-4. Because of this lack of information and understanding, District staff is less able to negotiate the monitoring requirements that apply to new regulatory permits or legal settlements. The result has been a proliferation of mandated, long-term monitoring projects that may be inefficient or even duplicative.

C-5. The basic underlying condition limiting the efficiency and effectiveness of the District's environmental monitoring activities is that environmental monitoring (and other environmental services, such as planning) -- having been fashioned to serve the needs of specific projects -- are now being redirected to also serve the District's new stream stewardship mandate.

C-6. The District environmental monitoring organizational structure and way of doing business lags behind the recent changes to the District mandate, mission, and ends policies, and this is the root source of many, if not most, of the identified shortcomings in the District's monitoring activities.

C-7. Because of the District's changing mandate, and because of increased regulatory emphasis on watershed sources and effects, the District's typical role of a passive partner or source of funding within collaborative monitoring programs may no longer be appropriate or sustainable.

C-8. It is impossible to accurately predict the exact monitoring needs that the District will have to address over the coming 15 years given the very complex, highly dynamic, and rapidly changing nature of the environmental monitoring arena.

C-9. What is clear, however, is that the District can and will need to become highly competent in the conduct, management, coordination, and integration of environmental monitoring projects.

C-10. The District possesses a number of strengths and advantages that it can leverage to achieve the competency it needs for meeting its complex and changing environmental monitoring needs.

C-11. The District is uniquely positioned with the potential to become the recognized definitive authority on the environmental resources and conditions within its streams and riverine ecosystems and on the related fields of habitat assessment, enhancement, restoration, and management.

The District's experience is not at all unique: most monitoring programs evolve in response to specific regulatory requirements. It is typical for these programs to re-design themselves to meet the more comprehensive objectives of environmental management and to improve program effectiveness and efficiency. The re-design should focus on up-front planning to meet environmental management objectives and on improving the synthesis, interpretation, and reporting of environmental data. The re-design should be accompanied by improvements to quality assurance/quality control and data management.

RECOMMENDATIONS

Overall Strategy:

In Chapter IV the project team considered three alternatives for improving the effectiveness and efficiency of the District's monitoring activities and recommended the following strategy to fit the District's needs, its structure and organization, and the nature of its projects and operations: **Organize and coordinate District monitoring activities to serve the needs of watershed management, while enhancing service to individual projects.**

Under this alternative, a set of watershed indicators would be developed that draws largely from data that is already being collected for current monitoring projects. Additional monitoring projects would be initiated where necessary to support a well-rounded and well-designed suite of indicators. Emphasis would be placed on organizing and reporting indicators to maximize the usefulness of data in management decision-making.

Future monitoring projects, including those negotiated as conditions of regulatory permits, would be designed in connection with an overall strategy for regulatory compliance. New monitoring activities would be designed, wherever possible, to support existing indicators or new indicators that would complement the existing suite of indicators. A quality assurance process would be integrated into the design of new projects to insure that new data was (to the extent practicable) comparable with existing data sets. New projects would adhere to standards for management of data and metadata and for project reporting.

By adopting this strategy the District will, over time, gain greater management control over its monitoring activities and be better able to use monitoring data in decision-making. This, in turn, should enable the District to save costs and better serve the community.

Specific Actions:

To clarify the recommended strategy and facilitate its execution, the project team broke the above described alternative into three interdependent components. The first part operates at the project level and affects improvements in the planning and execution of individual activities. The second addresses the District's monitoring needs for advancing its stream stewardship and watershed management objectives and achieves higher effectiveness and efficiency at the overall programmatic level. The third part focuses on the District's interface with external drivers and pursues enhancements in the District's interactions with regulatory agencies and collaborative efforts.

It is crucial to remain mindful however, that only when these three parts are proceeding in concert will the aggregate strategy likely achieve the level of coherence and viability necessary to realize the needed improvements in the overall effectiveness and efficiency of the District monitoring activities. The recommended parts are as follows:

I. Make Project-Specific Monitoring Plans More Efficient and Effective.
To successfully balance project-specific focus (on obtaining permits and approvals) with the District's longer-term watershed stewardship objectives, the District should improve collaborative relationships between staff responsible for implementing projects (on the one hand) and the scientists and environmental policy experts responsible for preparing environmental documentation, obtaining permits, and implementing monitoring and mitigation plans (on the other). These relationships will require some structural and process changes for the collaboration to be effective and efficient.

Furthermore, to overcome the project-specific compartmentalization of monitoring activities, and the resulting inconsistency in quality and methods, the District should establish a centralized and uniform quality assurance/quality control (QA/QC) process for monitoring projects. This QA/QC should focus on the planning stages of monitoring projects. In particular, new monitoring plans should undergo a formalized data quality objectives (DQO) process. By implementing a consistent set of QA/QC requirements, including requirements for the preparation of project reports, the District will facilitate compilation and analysis of data across projects. This will, in time, enable the District to make better use of the data and to better target future monitoring efforts.

This component of the overall strategy can be pursued through the following steps and initiatives:

- I.A. Develop and implement a process to facilitate communication and collaboration between project managers and staff scientists.
  - I.A.1. Develop procedures to facilitate collaboration when monitoring projects are initiated.
  - I.A.2. Develop protocols for project managers to incorporate ecological services into project budgets and incorporate these protocols in Engineering Policies and Procedures.
  - I.A.3. Develop and implement a system for tracking monitoring commitments and staff hours required to fulfill commitments.
  - I.A.4. Develop and implement a system for tracking hours expended on, and data obtained from, "ad-hoc" surveys and monitoring.
- I.B. Implement a Uniform Quality Assurance Process for Monitoring Projects
  - I.B.1. Develop format and requirements for preliminary project plans.
  - I.B.2. Establish a Data Quality Objectives (DQO) process.
  - I.B.3. Adapt USEPA quality assurance requirements to be suitable to the types of monitoring done by the District and to the District's organizational structure.

- I.B.4. Develop requirements for Quality Assurance Project Plans.
- I.B.5. Develop standards for delivery of data and metadata.
- I.B.6. Develop and implement standards for preparation, publication, and dissemination of monitoring reports.

I.C. Develop and implement a process for peer review and public review of District monitoring projects.

II. Enhance the District's ability to use monitoring information in watershed management.
In order to provide a basis for both management decision-making and public involvement in, and support for, the District's work, the District should develop a system for synthesizing, interpreting, and reporting biological and surface water quality monitoring data. To do so, the District should institute a process for routinely organizing environmental data into indicators. The indicators, placed in proper context, create the basis for a compelling story about the watershed, its habitats, the multiple functions of its streams, and the District's work to maintain and improve it. Additionally, for the system to be effective it must ultimately culminate in an annual report on the status of the watershed and the District's stewardship efforts.

This component of the overall strategy can be pursued through the following steps and initiatives:

- II.A. Facilitate Consensus on Monitoring Objectives
  - II.A.1. Communicate improvement objectives and plans to management and staff.
  - II.A.2. Develop and implement a collaborative process for involving external stakeholders in determining monitoring objectives
  - II.A.3. Benchmark other programs.

- II.B. Create a District Process to Synthesize, Interpret and Report Monitoring Data.
  - II.B.1. Develop problem statements, conceptual models, and management questions.
  - II.B.2. Develop a preliminary set of indicators.
  - II.B.3. Assess which indicators are supported by current monitoring commitments or data from regional programs and other external sources.
  - II.B.4. Identify additional monitoring required to support indicators and initiate monitoring projects.
  - II.B.5. Develop and implement a process for indicator-based annual reporting of the status of District watersheds.

- II.C. Present process to District management.

III. Insure that Future Monitoring Commitments Are Part of a Coordinated Strategy that Includes Regulatory Compliance.
As the business of managing the watershed gets ever more complex (with more players and more policy issues to consider at every step), the District needs to better coordinate its environmental planning and regulatory compliance activities and adopt a forward-thinking, strategic view. That strategic view should influence what data is to be collected, how and where it is collected, and how and where it is reported. Staff responsible for the overall monitoring program should be involved whenever environmental mitigation or monitoring is discussed in connection with project-specific permits, legal considerations, or regulatory issues.

To enable staff to track and coordinate monitoring activities, the District needs to develop better data management structures and procedures. As an initial step, which may prove adequate to this need, the District should establish a tracking database to (1) facilitate access to monitoring data and (2) enable staff to track the status of monitoring projects and insure that they are complying with District procedures and QA/QC requirements.

This component of the overall strategy can be pursued through the following steps and initiatives:

- III.A. Develop and implement procedures to incorporate District monitoring objectives and standards into regulatory negotiations and commitments.
  - III.A.1. Assign staff responsible for coordination and oversight of the monitoring program to participate in discussions of regulatory or legal settlements that may involve monitoring.
  - III.A.2. Maintain and communicate clear policy directions and management objectives in coordinating and improving District participation in regional monitoring collaboratives (SCBWMI, SCVURPPP, BASMAA, RMP, SFC JPA).
  - III.A.3. Implement a strategy for identifying and addressing outstanding commitments and systematic review and update of their status with the regulatory agencies.
- III.B. Improve Accessibility and Usability of District Environmental Data.
  - III.B.1. Develop a management-level tracking system.
  - III.B.2. Develop project-specific database requirements.

Further elaborations on and breakdown of the above recommendations are provided in chapter V.

NEXT STEPS

A detailed implementation plan under separate covers presents the staffing and organizational changes needed to implement these recommendations as well as schedule and budgets.

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Appendix A—CIP Project-Specific Information

Appendix B—Project Activity/Monitoring Matrix.

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Acronyms

BASMAA	Bay Area Storm Management Agencies Association
BMPs:	Best Management Practices
CALFED	The CALFED Bay-Delta Program
CCP	Coyote Creek Flood Control Project
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CGSU	CADD/Geographic Services Unit
CHCs	Chlorinated Hydrocarbons
CHCWG	Chlorinated Hydrocarbon Work Group
CIP	Capital Improvement Program
CMMS	Computerized Maintenance Management System
CWA	Clean Water Act
CWPU	Countywide Watershed Programs Unit
DDT	Dichlorodiphenyltrichloroethane
DQA	Data Quality Objectives
EDC	Endocrine Disrupting Chemicals
EDMS	Electronic Document Management System
EIR	Environmental Impact Report
ESU	Ecological Services Unit
FAHCE	Fisheries and Aquatic Habitat Collaborative Effort
FCP:	Flood Control Projects
FR	Federal Register
FW:	Freshwater wetlands
GIS	Geographic Information System
GRP	Downtown Guadalupe River Flood Control Project
HCP	Habitat Conservation Plan
ISMP	Information Systems Master Plan
ITAC	Information Technology Advisory Committee
MAEP	Monitoring Activities Evaluation Project
MAER	Monitoring Activities Evaluation Report
MMP	Mitigation and Monitoring Plan
MOUs	Memoranda of Understanding
NCCP	Natural Community Conservation Planning
ND	Negative Declaration
NEPA	National Environmental Policy Act
NEPA	National Environmental Protection Act
NGOs	Non-governmental organizations
NPDES	National Pollution Discharge Elimination System
NRC	National Research Council
NRDA	Natural Resources Damage Assessment
OCWM	Office of Countywide Watershed Management
OWH:	Open water habitat
PAH	Polyaromatic Hydrocarbons
PBDE	Polybrominated diphenyl ethers
PCBs	Polychlorinated Biphenyles
PEAP	Performance, Effectiveness, and Accountability Program
POTW	Publicly Owned Treatment Works
QA	Quality Assurance
QAPP	Quality Assurance Project Plan

QC	Quality Control
RCU	Regulatory Compliance Unit
RFW:	Riparian forest and woodlands
RMAS	Regional Monitoring and Assessment Strategy
RMP	Regional Monitoring Plan
RNG:	Ruderal/Non-native grasslands.
RWQCBs	Regional Water Quality Control Boards
RWTDP:	Raw Water Transmission and Distribution Projects
SCBWMI	Santa Clara Basin Watershed Management Initiative
SCP	Scientific Collection Permit
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SCVWD	Santa Clara Valley Water District
SEIDP	Stormwater Environmental Indicators Demonstration Project
SFCJPA	San Franciscquito Creek Joint Powers Authority
SFEI	San Francisco Estuary Institute
SFEI	San Francisco Estuary Institute
SFRWQCB:	San Francisco Regional Water Quality Control Board
SMP	Stream Maintenance Program
SMSTOPPP	San Mateo Stormwater Pollution Prevention Program
SOSP:	Source of Supply Projects
SRA:	Shaded Riverine Aquatic
SWAMP	Surface Water Assessment and Monitoring Program
SWM:	Salt water marsh
SWOT	Strengths, Weaknesses, Opportunities, and Threats
SWQIP	Surface Water Quality Improvement Program
SWRCB:	State Water Resources Control Board
TBM:	Tidal brackish marsh
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
TWTDP:	Treated Water Transmission Distribution Projects
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VMU	Vegetation Management Unit
WPSU	Watershed Program Support Units (Guadalupe, Coyote & Llagas/Uvas, West Valley & Lower Peninsula)
WPU	Watershed Planning Unit
WQU	Water Quality Unit
WSSP:	Watershed and Stream Stewardship Projects
WTP:	Water Treatment Projects

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I. INTRODUCTION

The Santa Clara Valley Water District ("District") is a special purpose governmental agency responsible for providing water supply and flood protection for Santa Clara County, California. For flood protection, all creeks in Santa Clara County with a watershed greater than 320 acres are in the District's jurisdiction. The mission of the District is a "healthy, safe and enhanced quality of living in Santa Clara County through the comprehensive management of water resources in a practical, cost-effective and environmentally sensitive manner."

In carrying out its mission, the District manages streams, canals, reservoirs, and dams, and builds, operates, and maintains water supply and flood conveyance facilities, groundwater recharge facilities, and water treatment and treated water distribution facilities. The District also builds and maintains habitat enhancement and/or restoration sites, and wetlands and other environmental compensatory mitigation sites. As a consequence, the District engages to varying degrees in a range of widespread and multifaceted biological, surface water quality, and stream functions monitoring activities throughout the San Francisco Bay Area.

Over the past few years, the monitoring requirements and needs associated with the District's projects, operations, and stream stewardship commitments have dramatically increased in volume, as well as in rigor and complexity. This trend is likely to continue into the foreseeable future. The following factors are contributing to this trend:

- Increased incorporation of adaptive management processes in environmental permits and stakeholder requirements associated with the design, construction, and operation of capital projects in streams;

- Extensive environmental mitigation and monitoring requirements recently negotiated into the 10-year permits for the multi-year stream maintenance program (SMP);

- Comprehensive adaptive management provisions anticipated to result from the Fisheries and Aquatic Habitat Collaborative Effort (FAHCE) agreements covering District operations in the three largest watersheds within the County;

- Federal and State agencies' implementation of Total Maximum Daily Load (TMDL) processes and Load Allocations for a number of pollutants in streams and reservoirs within the District jurisdiction; and

- The need to demonstrate the District's achievements relative to its commitments under the Clean, Safe Creeks and Flood Protection program (Measure B) over the coming 15 years.

Given the looming increases in environmental monitoring needs throughout the District and the limited resources available for monitoring purposes in general, the District must find ways of maximizing the informational output from these efforts while minimizing wasteful and redundant activities. To that end, the Office of Countywide Watershed Management (OCWM) has begun an initiative to improve the effectiveness and efficiency of District monitoring efforts. The OCWM's improvement initiative will focus primarily on the monitoring activities associated with the CIP and watershed management operations and will proceed through the following three phases:

Phase 1—Evaluation:

This phase consists of a) reviewing current activities and commitments, b) projecting the District's future monitoring needs, c) reviewing collaborative monitoring opportunities in the region, d) evaluating relevant trends in environmental regulations, sciences, and management of monitoring programs, e) developing and evaluating alternative strategies for improving efficiency and effectiveness, f) recommending a preferred alternative, and g) presenting specific actions and steps to implement the preferred strategy .

Phase 2—Planning:

This phase consists of developing a detailed implementation plan for carrying out the recommendations made in the Evaluation report. The implementation plan will detail the goals, objectives, tasks, schedules, budgets, and roles and responsibilities for each of the elements that will be necessary to pursue the recommendations of the MAER.

Phase 3—Implementation:

This phase consists of the implementation of the improvement strategies following on-going improvement cycles of planning, doing, checking, acting, and planning.

The Evaluation and Planning phases are referred to in this document as the Monitoring Activities Evaluation Project (MAEP).

I.A. Vision

As a first step in embarking on the initial evaluation and planning phases, the OCWM articulated the following vision of what the overall improvement initiative will aim to achieve:

> "To have an efficient and effective countywide monitoring program that provides ecological information of a quality and in a format that are necessary for meeting our regulatory commitments, supporting District capital programs, providing assessments of creek and bay ecosystems health, and tracking the District impacts on watersheds, streams, and the natural resources therein (Ends Policy E-3.1)"

The evaluation and planning phases will focus only on those elements of the District activities that are integral to pursuing that vision.

I.B. Definitions

To better delineate the scope of this improvement initiative and its constituent phases, the following definitions are adhered to as much as possible:

I.B.1. Monitoring:

A team of District biologists and planners developed the following definition as part of the Natural Resources Management Program, which has since been discontinued:

> "Monitoring is the processes of measuring specific ecological phenomenon over time to gain a greater understanding of how an ecosystem functions or responds to some action. Monitoring can be site-specific or regional in scope and may include special studies and experimental approaches. Monitoring is done to help ensure compliance with regulatory requirements and to take corrective actions, to better estimate the impacts of planned projects, to improve environmental planning, to establish baseline conditions or to determine the effectiveness or impact of management decisions."

The above definition is consistent with the following more general definition presented by the National Research Council's (NRC) Committee on a Systems Assessment of Marine Environmental Monitoring in their 1990 report *Managing Troubled Waters—The Role of Marine Environmental Monitoring*:

> "...environmental monitoring is defined as the continuing program of modeling, measurement, analysis, and synthesis that predicts and quantifies environmental conditions or contaminants and incorporates that information effectively into decision making in environmental management."

For the purposes of this project, and based on the above definitions, monitoring will be taken to refer to all District activities, including planning and project management, associated with the collection, management, analysis, and presentation of in-situ ecological data over time.

I.B.2. Effectiveness:

In general, effectiveness is the degree to which an effort achieves its intended purpose. An action is fully effective if it achieves its intended purpose fully.

At the District, the effectiveness of a monitoring project/program has been measured, for the most part, by the degree to which the outcome satisfies applicable permit or regulatory requirements, whether or not we have actually learned anything in the process.

That understanding of effectiveness will continue to be relevant to the District's monitoring efforts on a project-by-project basis. However, due to the recent amendment to the District mission, the criteria for effectiveness of individual projects and of the overall monitoring program will need to be expanded. To be effective, monitoring projects need to also succeed in, or contribute to, answering relevant questions, clarifying key issues, or increasing the knowledge and understanding of ecological systems within the District's jurisdiction.

*For this review therefore, District monitoring efforts are considered fully effective if they meet regulatory requirements, answer relevant questions that are used to make engineering and management decisions, **and** enhance the quality and applicability of negotiated monitoring requirements.*

I.B.3. Efficiency:

In the general sense, efficiency is a measure of the effort expended in an activity relative to the benefits realized from that activity. As commonly understood, achieving higher efficiency is basically "getting more for less," or "maximizing output while minimizing input."

In environmental monitoring, the notion of efficiency hinges on the distinctions between information and data. What is sought after in a monitoring activity is the information or knowledge that can be gained from the exercise and not just the data that are generated. To get information, data have to be assembled, aggregated, analyzed, presented, etc., and not just collected.

Therefore, improving efficiency in environmental monitoring can usefully be defined as maximizing the information gained from a monitoring activity while minimizing the effort involved and the amount of data collected in the process.

I.C. Approach and Methodology

The OCWM relied as much as practicable on external, third-party perspectives and expertise to obtain impartial analyses and presentations. The evaluation and planning phases of this improvement initiative are funded primarily through the Performance, Effectiveness, and Accountability Program (PEAP). PEAP is a program administered by the CEO to finance projects that aim at improving organizational performance.

Effectiveness and efficiency are obviously interrelated. For the purposes of this project we use the notion of effectiveness to focus on the issues relating to "what" the District monitors, and use "efficiency" to focus on "how" the District does that monitoring. Although somewhat arbitrary, the delineation is just one way of breaking down the inherently complex problems of managing environmental monitoring in order to come up with practical improvement strategies and specific management recommendations.

The MAEP team consisted of a) Stillwater Sciences, a local consultancy specializing in ecosystem, watershed, and riverine sciences who brings extensive expertise and experience in biological monitoring, habitat enhancement and restoration, and environmental documentation and permitting, b) Mr. Dan Cloak, P.E., of Dan Cloak Environmental Consulting, who brings broad expertise and experience in the legal and regulatory frameworks of environmental monitoring and in the design and implementation of large, regional surface water quality and biological monitoring programs, and c) Mr. Neddal Ali-Adeeb, who brings in-depth knowledge of District operations, activities, and organizational structures and programs and extensive background and experience in environmental compliance, sediment characterization, surface water and groundwater quality monitoring, program design, and project management in the private and public sectors.

The review proceeded through a series of interviews, discussions, meetings, correspondences, conversations and other means of interchange between project team members and District staff members who are directly or indirectly involved in all aspects of biological or water quality monitoring within the District. The project team utilized written questionnaires and facilitated meetings to obtain information on current monitoring projects, framework, and related organizational and programmatic issues. We relied on the most current planning documents to the extent that they were readily available, and on interviews with the project managers or lead personnel when written documentation of relevant information was not available. A list of references is provided at the end of the report.

I.D. Document Structure

This monitoring activities evaluation report (MAER) presents the findings and outcomes of Phase 1 of the improvement initiative and is organized into the following chapters:

I. Introduction: Presents general descriptions of the District mission, operations and activities, a brief summary of the reasons for, and the goal and scope of the project, definitions of key terms, the methodology and approach of this review, and the structure of this document.

II. Background: Includes descriptions of the geographic, environmental, and regulatory settings for District operations, the regulatory drivers and District policies that influence monitoring needs, and the District projects and programs with environmental monitoring components.

III. Evaluation of District Monitoring Activities: Presents the findings of the review in terms of current monitoring activities and commitments, collaborative monitoring activities and opportunities, projected future monitoring needs, issues and trends in environmental monitoring likely to affect District needs, and the framework in which monitoring activities are currently carried out. A summary of the key findings is presented in the last section of this chapter.

IV. Needs Assessment & Alternatives Evaluation: States the problems that need to be addressed and presents possible improvement strategies by first elaborating on the key findings of this review, then by describing the outcomes of a Strengths, Weaknesses, Opportunities, and Threats (SWOT) session conducted with the environmental monitoring community within the District, summarizing twelve lessons learned from the redesign experiences of three regional monitoring programs in the Bay Area, analyzing the factors inhibiting effectiveness and efficiency within the District's monitoring efforts, and discussing three alternative strategies for improving the effectiveness and efficiency of District monitoring activities.

V. Conclusions: Presents the conclusions of this review and evaluation project in terms of the characteristics and trends of environmental monitoring by the District, factors affecting effectiveness and efficiency of environmental monitoring, and the recommended improvement strategy.

VI. Recommendations: Presents detailed recommendations for initiatives and steps for carrying out the recommended strategy in pursuit of the vision for the environmental monitoring programs articulated at the outset of this investigation.

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II. BACKGROUND

The purpose of this chapter is to provide an overview of the geographic, environmental, and regulatory settings in which District monitoring activities occur. This chapter also summarizes key features of the programs and projects within the District that have direct bearing on the amount and types of District monitoring activities. Those programs and projects are the focus of this evaluation project. These overviews are presented here to give a general sense of the breadth and complexity of ecological monitoring activities that often must accompany District operations and which a robust monitoring program must be able to accommodate in an efficient, effective, and on-going manner.

The materials in the following sections on the settings for District monitoring activities are synopses extracted from the "Draft Environmental Impact Report and Stream Maintenance Program Report for the Multi-Year Stream Maintenance Program" dated March 28, 2001. The reader is referred to the original documents for detailed information and for more exhaustive treatment of the subject matter.

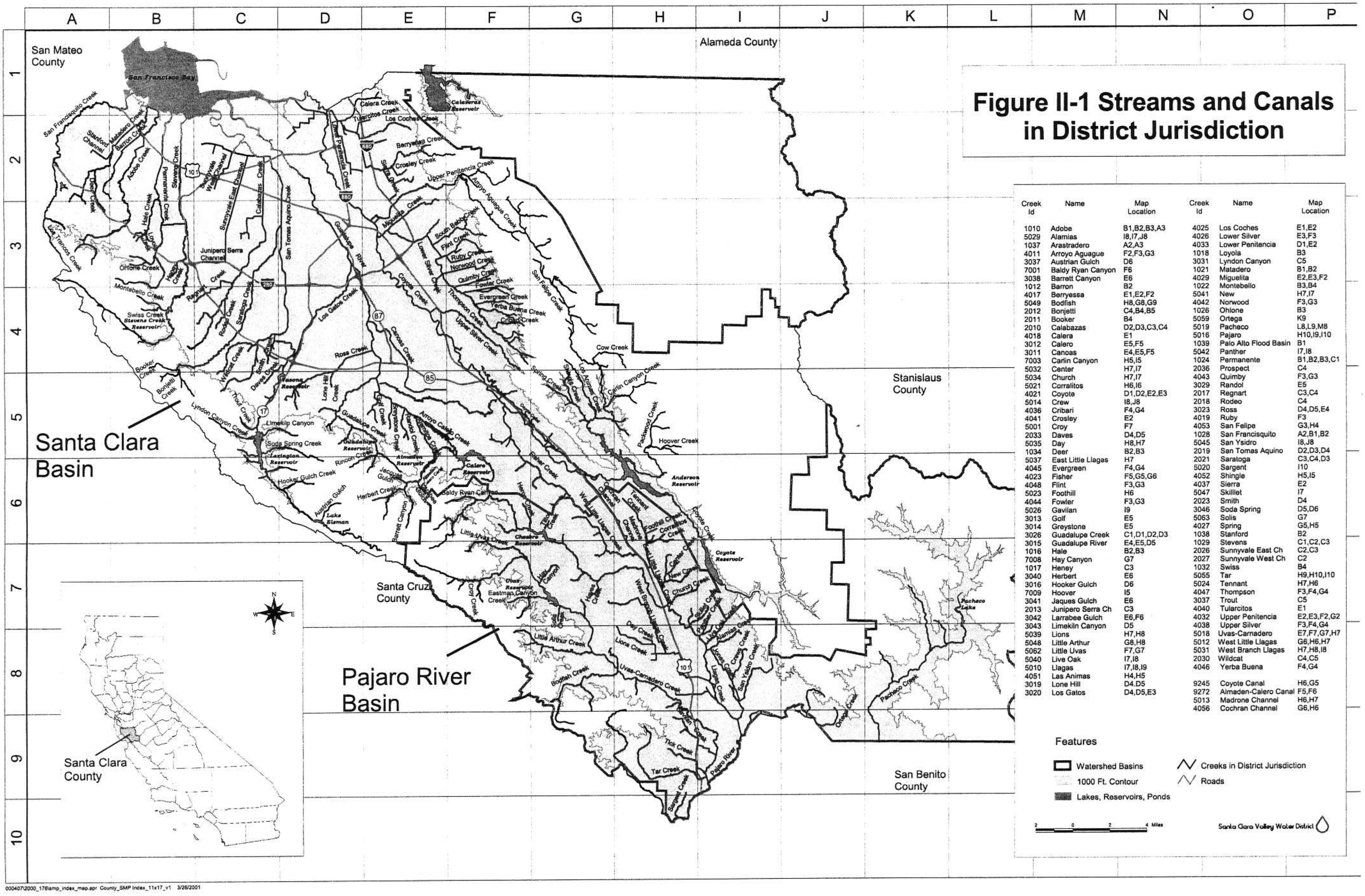
II.A. Geographic Setting

The District is responsible for water supply and flood protection in Santa Clara County, California. Santa Clara County lies at the southern end of the San Francisco Bay in the central Coast Range of California. Mountainous areas cover approximately two-thirds of the county. The valley areas where most of the District activities are carried out extend through the center of the county, southeasterly form San Francisco Bay in the north to the Hollister Basin in San Benito County in the south. The valley area comprises three interconnecting basins: the Santa Clara Valley, the Coyote Valley and the Llagas Basin.

Santa Clara County has four distinct landscapes units: 1) the Santa Cruz Mountain uplands along the western boundary, 2) Diablo Range uplands on the east, 3) foothills, and 4) bay plains and alluvial valleys between the base of the mountains and the shoreline of the San Francisco Bay.

The District is divided into two major hydrologic basins draining either into the San Francisco Bay or the Monterey Bay. In the northern portion of the County, streams of the Santa Clara Basin drain to the San Francisco Bay. To the south, streams in the Pajaro River Basin drain ultimately to Monterey Bay. Streams in the northeast portion of Santa Clara County are not in an established flood control zone and are not in the jurisdiction of the District. (See Figure II-1, Streams and Canals in District Jurisdiction.) Table II-1 lists the two basins, five flood control zones, and 15 incorporated cities of Santa Clara County.

Figure II-1 Streams and Canals in District Jurisdiction



Creek Id	Name	Map Location	Creek Id	Name	Map Location
1010	Adobe	B1,B2,B3,A3	4025	Los Coches	E1,E2
5029	Alamias	I8,I7,J8	4026	Lower Silver	E3,F3
1037	Arastradero	A2,A3	4033	Lower Penitencia	D1,E2
4011	Arroyo Aguague	F2,F3,G3	1018	Loyola	B3
3037	Austrian Gulch	D6	3031	Lyndon Canyon	C5
7001	Baldy Ryan Canyon	F6	1021	Matadero	B1,B2
3038	Barrett Canyon	E6	4029	Miguelita	E2,E3,F2
1012	Barron	B2	1022	Montebello	B3,B4
4017	Berryessa	E1,E2,F2	5041	New	H7,I7
5049	Bodfish	H8,G8,G9	4042	Norwood	F3,G3
2012	Bonjetti	C4,B4,B5	1026	Ohlone	B3
2011	Booker	B4	5059	Ortega	K9
2010	Calabazas	D2,D3,C3,C4	5019	Pacheco	L8,L9,M8
4018	Calera	E1	5016	Pajaro	H10,I9,I10
3012	Calero	E5,F5	1039	Palo Alto Flood Basin	B1
3011	Canoas	E4,E5,F5	5042	Panther	I7,I8
7003	Carlin Canyon	H5,I5	1024	Permanente	B1,B2,B3,C1
5032	Center	H7,I7	2036	Prospect	C4
5034	Church	H7,I7	4043	Quimby	F3,G3
5021	Corralitos	H6,I6	3029	Randol	E5
4021	Coyote	D1,D2,E2,E3	2017	Regnart	C3,C4
5014	Crew	I8,J8	2018	Rodeo	C4
4036	Cribari	F4,G4	3023	Ross	D4,D5,E4
4041	Crosley	E2	4019	Ruby	F3
5001	Croy	F7	4053	San Felipe	G3,H4
2033	Daves	D4,D5	1028	San Francisquito	A2,B1,B2
5035	Day	H8,H7	5045	San Ysidro	I8,J8
1034	Deer	B2,B3	2019	San Tomas Aquino	D2,D3,D4
5037	East Little Llagas	H7	2021	Saratoga	C3,C4,D3
4045	Evergreen	F4,G4	5020	Sargent	I10
4023	Fisher	F5,G5,G6	4052	Shingle	H5,I5
4048	Flint	F3,G3	4037	Sierra	E2
5023	Foothill	H6	5047	Skillet	I7
4044	Fowler	F3,G3	2023	Smith	D4
5026	Gavilan	I9	3046	Soda Spring	D5,D6
3013	Golf	E5	5063	Solis	G7
3014	Greystone	E5	4027	Spring	G5,H5
3026	Guadalupe Creek	C1,D1,D2,D3	1038	Stanford	B2
3015	Guadalupe River	E4,E5,D5	1029	Stevens	C1,C2,C3
1016	Hale	B2,B3	2026	Sunnyvale East Ch	C2,C3
7008	Hay Canyon	G7	2027	Sunnyvale West Ch	C2
1017	Heney	C3	1032	Swiss	B4
3040	Herbert	E6	5055	Tar	H9,H10,I10
3016	Hooker Gulch	D6	5024	Tennant	H7,H6
7009	Hoover	I5	4047	Thompson	F3,F4,G4
3041	Jaques Gulch	E6	3037	Trout	C5
2013	Junipero Serra Ch	C3	4040	Tularcitos	E1
3042	Larrabee Gulch	E6,F6	4032	Upper Penitencia	E2,E3,F2,G2
3043	Limekiln Canyon	D5	4038	Upper Silver	F3,F4,G4
5039	Lions	H7,H8	5018	Uvas-Carnadero	E7,F7,G7,H7
5048	Little Arthur	G8,H8	5012	West Little Llagas	G6,H6,H7
5062	Little Uvas	F7,G7	5031	West Branch Llagas	H7,H8,I8
5040	Live Oak	I7,I8	2030	Wildcat	C4,C5
5010	Llagas	I7,I8,I9	4046	Yerba Buena	F4,G4
4051	Las Animas	H4,H5			
3019	Lone Hill	D4.D5	9245	Coyote Canal	H6,G5
3020	Los Gatos	D4,D5,E3	9272	Almaden-Calero Canal	F5,F6
			5013	Madrone Channel	H6,H7
			4056	Cochran Channel	G6,H6

Features

- ▭ Watershed Basins
- ▨ 1000 Ft. Contour
- ■ Lakes, Reservoirs, Ponds
- ∧∕ Creeks in District Jurisdiction
- ∧∕ Roads

2 0 2 4 Miles

Santa Clara Valley Water District

000407\2000_176\smp_index_map.apr County_SMP Index_11x17_v1 3/26/2001

Table II - 1: Flood Control Zones

Flood Control Zone	Land Area (square miles)	Creek Length (miles)	Cities in Zone
Northwest	97	108	Cupertino, Los Altos, Los Altos Hills, Mountain View, Palo Alto, Sunnyvale
North Central	85	87	Campbell, Cupertino, Los Gatos, Monte Sereno, Saratoga, San Jose, Santa Clara, Sunnyvale
Central	175	133	Campbell, Los Gatos, San Jose, Santa Clara
East	359	259	Milpitas, Morgan Hill, San Jose
Santa Clara Basin Subtotal	*716*	*587*	
South Zone Pajaro River Basin Subtotal	*370*	*241*	*Gilroy, Morgan Hill, San Jose*
SMP Work Area Total	***1086***	***828***	

Source: SCVWD, TRA, 3/01

The principle drainage in the Santa Clara and Coyote Valleys is the Coyote Creek. Coyote Creek originates in the Diablo Range and enters the Coyote Valley at its topographic divide with the Llagas Basin. The creek flows northwesterly through Coyote Valley and Santa Clara Valley before entering San Francisco Bay. Other major drainages that pass through Santa Clara Valley include Guadalupe River, Los Gatos Creek, San Tomas Aquino Creek, Saratoga Creek, Calabazas Creek, Stevens Creek and Permanente Creek, all of which originate in the Santa Cruz Mountains. Drainages entering Santa Clara Valley from the Diablo Range are smaller, reflecting the steeper terrain and generally drier climatic conditions. Of these, the larger streams are Penitencia Creek and Berryessa Creek. The drainages of the Llagas basin are tributaries to the Pajaro River, which eventually enters the Pacific Ocean at Monterey Bay. Principal drainages of the Llagas Basin are Llagas Creek and Uvas Creek, both of which originate in the Santa Cruz Mountains.

District operations and activities are generally carried out in streams and canals and on adjacent District property and easements. The District's jurisdiction on a stream begins at that point where 320 acres (½ square mile) of watershed drain to the stream, and continues downstream to San Francisco Bay or the limits of the Pajaro River in Santa Clara County. This area throughout the Santa Clara County consists of 191 streams for approximately 828 miles and 10 canals for approximately 41 miles. (See Figure II-1, Streams and Canals in District Jurisdiction)

II.B. Environmental Setting

District activities affect salt and brackish marsh habitat in tidal areas and freshwater wetland, riparian forest and woodland, ruderal/non-native grassland, and open water habitat in non-tidal areas. Within these habitats, regional differences between the north, south, and east portions of the county occur due to slope, exposure, climate, rainfall, and geology. The cooler and wetter areas are in the higher elevations of the Santa Cruz Mountains (the west slopes of Santa Clara County); the warmer, drier sites are on the valley floor and in the eastern and southern sections.

II.B.1. Tidal salt marsh:

Salt marsh occupies the intertidal zone in the lower, tidal reaches of the creeks surrounding south San Francisco Bay. Salt marsh vegetation is generally found immediately adjacent to the Bay or its major sloughs where the water is relatively saline.

In San Francisco Bay in general, the lower salt marsh supports monotypic stands of California cordgrass (*Spartina foliosa*), while the mid to upper elevations are dominated by pickleweed (*Salicornia virginica*). Other native and non-native peripheral halophytes (salt tolerant plants) including spearscale (*Atriplex triangularis*), alkali heath (*Frankenia salina*), salt grass (*Distichlis spicata*), and brass buttons (*Cotula coronopifolia*) are occasionally present, especially at the wetland/upland interface.

Tidal salt marshes provide habitat for several special-status species, including California clapper rails (*Rallus longirostris obsoletus*), Alameda song sparrows (*Melospiza melodia pusilla*), salt marsh harvest mice (*Reithrodontomys raviventris raviventris*), and salt marsh wandering shrews (*Sorex vagrans halicoetes*).

Fish species occurring in the salt marshes are not well known but may include Pacific herring (*Clupea pallasi*) and striped bass (*Morone saxatilis*), as well as anadromous fish (steelhead [*Oncorhynchus mykiss*] and Chinook salmon [*O. tshawytscha*]) in the spring and fall. Amphibians tend to be absent from salt marsh habitats due to their requirement of fresh water. Gopher snakes (*Pituophis melanoleucus*) and other reptiles forage on the levees within the salt marshes but generally not in the salt marsh habitat itself. Introduced Norway rats (*Rattus norvegicus*) and red foxes (*Vulpes vulpes*) do forage within the salt marsh habitat, and are significant clapper rail predators.

Numerous aquatic, semiaquatic, and terrestrial birds, including grebes, cormorants, herons, ducks, raptors, rails, plovers, sandpipers, gulls, and songbirds inhabit South Bay salt marshes. Commonly observed species include western grebes (*Aechmophorus occidentalis*), double-crested cormorants (*Phalacrocorax auritus*), snowy egrets (*Egretta thula*), northern pintails (*Anas acuta*), mallards (*A. platyrhynchos*), ruddy ducks (*Oxyura jamaicnesis*), northern harriers (*Circus cyaneus*), American coots (*Fulica americana*), black-bellied plovers (*Pluvialis squatorola*), black-necked stilts (*Himantopus mexicanus*), American avocets (*Recurvirostra americana*), willets (*Catoptrophorus semipalmatus*), western sandpipers (*Calidris mauri*), dunlins (*C. alpina*), long-billed dowitchers (*Limnodromus scolopaceus*), long-billed curlews (*Numenius americanus*), whimbrels (*N. phaeopus*), greater yellow-legs (*Tringa melanoleuca*), Forster's terns (*Sterna forsteri*), western gulls (*Larus occidentalis*), Bonaparte's gulls (*L. philadelphia*), marsh wrens (*Cistothorus palustris*), and song sparrows (*Melospiza melodia*).

II.B.2. Tidal brackish marsh:

Brackish marshes occur in tidal reaches of leveed streams upstream of salt marsh areas, where freshwater inflow markedly reduces the salinity of the incoming tidal water. Tidal influence in the South Bay generally does not extend upstream of U.S. Highway 101.

The more saline brackish marshes are dominated by alkali bulrush (*Scirpus robustus*). California bulrush (*Scirpus californicus*) often occupies a narrow strip in the lower marsh, adjacent to the low-flow channel. Lower-salinity brackish marshes are dominated by California bulrush and cattails (*Typha* spp.). Perennial pepperweed (*Lepidium latifolium*; also known as peppergrass), an invasive, non-native species, is sometimes a significant or even dominant component of brackish marshes. In some areas, fresher brackish marshes are dominated by a suite of lower-stature species, rather than cattails and bulrush. A variety of species may be present, including marsh pepper (*Polygonum punctatum*), marsh primrose (*Ludwigia peploides* ssp. *peploides*), cocklebur (*Xanthium strumarium*), tall cyperus (*Cyperus eragrostis*) and curly dock (*Rumex crispus*). These areas often correspond to areas treated with herbicides.

Brackish marshes support several special-status wildlife species including saltmarsh common yellowthroat (*Geothlypis trichas sinuosa*) and some of the species also found in salt marshes, such as Alameda song sparrows.

Many wildlife species that are found in either or both freshwater wetland and salt marsh habitats also occur in brackish marshes. Most amphibian and reptile species tend to be absent from brackish marshes, with the exception of bullfrogs (*Rana catesbeiana*), western aquatic garter snakes (*Thamnophis atratus*), western terrestrial garter snakes (*T. elegens*), and western pond turtles (*Clemmys marmorata*). Common bird species typically found in brackish marshes include pied-billed grebes (*Podilymbus podiceps*), black-crowned night herons (*Nycticorax nycticorax*), mallards, American widgeon (*Anas americana*), American coots, California gulls (*Larus californicus*), western gulls, common tern (*Sterna hirundo*), Forster's terns, black phoebes (*Sayornis nigricans*), and barn swallows (*Hirundo rustica*). Mammals commonly found in brackish marshes include native species such as California voles (*Microtus californicus*) and non-native species such as feral house cats (*Felis felis*), red foxes, Norway rats, and muskrats (*Ondatra zibethinus*). The first three non-native species all are significant predators of native birds.

II.B.3. Freshwater wetlands:

Freshwater wetlands occupy earthen and sediment-covered concrete channel beds in non-tidal reaches of District streams. Wetlands are particularly abundant in modified streams that are supplied with water throughout the summer. Streams not subject to these modifications contain smaller, patchy areas of freshwater wetland and tend to support riparian forest and woodland instead.

There are three general categories of vegetation within the freshwater wetlands in District-jurisdiction channels, as defined by dominant vegetation. These are categorized as 1) erect emergents, 2) creeping emergents, and 3) non-native/annual mix types.

Broad-leaved cattails (*Typha latifolia*) typically dominate erect emergent vegetation, but other tall, rhizomatous, grass-like species, such as tule (*Scirpus acutus* var. *occidentalis*), California bulrush, narrow-leaved cattail (*Typha angustifolia*) and broad-fruited bur-reed (*Spaganium eurycarpum* ssp. *eurycarpum*) are sometimes present or dominant.

Creeping emergent vegetation is common and abundant within the District's jurisdiction. Watercress (*Rorippa nasturtium-aquaticum*) and water primrose are the most abundant species. They each form extensive, dense, almost monotypic vegetation mats in some locations. Other typical native and non-native components include water smartweeds (*Polygonum punctatum*, *P. lapathifolium*, *P. hydropiperoides*), common willow-herb (*Epilobium ciliatum* ssp. *ciliatum*), tall cyperus, and water speedwell (*Veronica anagallis-aquatica*).

The non-native/annual mix vegetation is dominated by a variety of weedy, non-native annual and perennial grasses and forbs such as dallis grass (*Paspalum dilatatum*), barnyard grass (*Echinochloa crus-galli*), rabbitfoot grass (*Polypogon monspeliensis*), Italian ryegrass (*Lolium multiflorum*), cocklebur (*Xanthium strumarium*), prickly ox-tongue (*Picris echioides*), lady's thumb (*Polygonum persicaria*), and marshpepper (*Polygonum hydropiper*).

Freshwater wetlands are used by a variety of special-status wildlife species for breeding, foraging, and as a source of water for drinking. California red-legged frogs (*Rana aurora draytonii*), western pond turtles, San Francisco garter snakes (*Thamnophis sirtalis tetra taenia*), and tricolored blackbirds (*Agelaius tricolor*) are some of the special-status wildlife species that inhabit freshwater wetlands.

A wide variety of common native and introduced species inhabit freshwater wetlands. Fish include prickly sculpin (*Cottus asper*), carp (*Cyprinus carpio*), threespine stickleback (*Gasterosteus aculeatus*), and tule perch (*Hysterocarpus traski*). Amphibians and reptiles include bullfrogs, Pacific tree frogs (*Hyla regilla*), western toads (*Bufo boreas*), common garter snakes (*Thamnophis sirtalis*), terrestrial garter snakes, and western aquatic garter snakes. Birds include pied-billed grebes, great egrets (*Ardea alba*), great blue herons (*A. herodias*), snowy egrets, Canada geese (*Branta canadensis*), mallards, gadwalls (*Anas strepera*), American coots, common moorhens (*Gallinula chloropus*), Forster's terns, ring-billed gulls (*Larus delawarensis*), black phoebes, song sparrows, marsh wrens, common yellowthroats, and barn swallows. Mammals include red foxes, raccoons (*Procyon lotor*), and muskrats. Species requiring year-round water of adequate depth, such as fish, and the fish-eating diving birds, such as pied-billed grebes and Forster's terns, can only utilize the drier wetland sites when adequate water is present. On the other hand, seasonal wetlands are important breeding habitat for common amphibians such as California newts (*Taricha torosa*) due to the absence of fish predators.

II.B.4. Riparian Forest and Woodland:

Riparian forests and woodlands occur adjacent to freshwater reaches of watercourses throughout Santa Clara County. Riparian habitats comprise the transition between the stream and the upland portion of the watershed. Natural riparian habitats are characterized by variable gradients of moisture and light, lush vegetation, and very high biological diversity. Riparian forests along District streams tend to be long and narrow, either intergrading into adjacent upland habitat, such as oak woodlands, ornamental landscaping, and other habitat, or constrained by adjacent land uses.

Deciduous cottonwood-willow riparian forest occurs primarily in the middle to lower watersheds where the water table is high or there is year-round flow. On drier sites, oak or oak-sycamore riparian forest or woodland may dominate. Numerous non-native species including northern California black walnut (*Juglans californica* var. *hindsii*), eucalyptus (*Eucalyptus* spp.), and tree-of-heaven (*Ailanthus altissimus*) are locally abundant and occur throughout riparian habitats in the District. The riparian vegetation mix in the upper watersheds is different from the lower watersheds of the valley floor. These differences are related to factors such as slope, channel morphology, flow, and the ability of plants to withstand periodic flooding.

Healthy, stratified riparian forest (i.e., having differing layers of vegetation) supports the greatest wildlife diversity of any of the habitats within the District's jurisdiction. Riparian habitats and adjacent woodlands provide habitat for many special-status species, including white-tailed kites (*Elanus leucuras*), Cooper's hawks (*Accipiter cooperi*), sharp-shinned hawks (*A. striatus*), California yellow warblers (*Dendroica petechia brewsteri*), and San Francisco dusky-footed woodrats (*Neotoma fuscipes annectens*).

Fish commonly found in streams associated with riparian habitat include native species such as California roach (*Hesperoleucus symmetricus*), Sacramento sucker (*Catostomus occidentalis*), threespine stickleback, rainbow trout, prickly sculpin, and riffle sculpin (*Cottus gulosus*), and introduced fishes such as green sunfish, largemouth bass (*Micropterus salmoides*), and mosquito fish (*Gambusia affinis*). In addition to the amphibians described above that are also found in freshwater wetlands, (i.e., Pacific tree frogs), amphibians such as arboreal salamanders (*Aneides lugubris*) are generally found only in forested habitats.

Common riparian birds include green herons (*Butorides striatus*), mallards, wood ducks (*Aix sponsa*), red-shouldered hawks (*Buteo lineatus*), belted kingfishers (*Ceryle alcyon*), downy woodpeckers (*Picoides pubescens*), Nuttall's woodpeckers (*P. nuttallii*), spotted towhees (*Pipilo maculatus*), Swainson's thrush (*Catharus ustulatus*), hermit thrush (*C. guttatus*), Bewick's wrens (*Thryomanes bewickii*), yellow-rumped warblers (*Dendroica coronata*), Wilson's warblers (*Wilsonia pusilla*), American robins (*Turdus migratorius*), house finches (*Carpodacus mexicanus*), Stellar's jays (*Cyanocitta stelleri*), mourning doves (*Zenaida macroura*), European starlings (*Sturnus vulgaris*), brown-headed cowbirds (*Molothrus ater*), Bullock's orioles (*Icterus bullockii*), black-headed grosbeaks (*Pheucticus melanocephalus*), Pacific-slope flycatchers (*Empidonax difficilis*), black phoebes, chestnut-backed chickadees (*Poecile refescens*), bushtits (*Psaltriparus minimus*), and ruby-crowned kinglets (*Regulus calendula*).

Mammalian species that use riparian areas include those listed above using freshwater wetland habitat and additional species such as Virginia opossums (*Didelphis virginiana*), Trowbridge's shrews (*Sorex trowbridgii*), broad-footed moles (*Scapanus latimanus*), western red bats (*Lasiurus blosevillii*), hoary bats (*L. cinerius*), Yuma myotis (*Myotis yumanensis*), deer mice (*Peromyscus maniculatus*), house mice (*Mus musculus*), California voles (*Microtus californicus*), Norway rats, fox squirrels (*Sciurus niger*), gray fox (*Urocyon cinereoargenteus*), and bobcats (*Lynx rufus*).

Vegetation that grows at the interface of the stream and adjacent riparian habitat and shades the water is known as shaded riverine aquatic habitat (SRA). The SRA vegetation is composed of overhead cover and instream cover. The overhead cover comprises overhanging riparian vegetation, and the instream cover comprises woody debris, such as roots and trunks, and aquatic plants. Large boulders and undercut banks also contribute to shading. The SRA shades the water and contributes leaf litter and insects to the stream. Stream shading is typically a critical component of healthy riparian corridors within the District.

II.B.5. Ruderal/Non-native grasslands:

Those areas that are devoid of riparian forest or scrub generally consist of ruderal/non-native grassland habitat. Wild oats (*Avena fatua*), ripgut brome (*Bromus diandrus*), soft chess (*Bromus hordeaceus*), Italian ryegrass (*Lolium multiflorum*), smilo grass (*Piptatherum miliaceum*), black mustard (*Brassica nigra*), wild radish (*Raphanus sativus*), star thistle (*Centaurea solstitialis*), English plantain (*Plantago lanceolata*), and sweet fennel (*Foeniculum vulgare*) are a few of the weedy species typical of this habitat. Riparian scrub species are sometimes sparsely distributed within these areas.

Although these non-native habitats are generally not as high in wildlife values as native habitat, many special-status wildlife species do use ruderal and non-native grassland habitats, including California horned lizards (*Phrynosoma coronatum frontale*), white-tailed kites (*Elanus caeruleus*), burrowing owls (*Athene cunicularia*), loggerhead shrikes (*Lanius ludovicianus*), and California horned larks (*Eremophila alpestris actia*).

Ruderal and non-native grassland habitats in Santa Clara County support numerous wildlife species, especially if the habitat is extensive, relatively well vegetated, or adjacent to other high-quality habitat (such as riparian). Western toads are found in these habitats, and reptiles using these habitats include western fence lizards (*Sceloporus occidentalis*), western skinks (*Eumeces skiltonianus*), gopher snakes, racers (*Coluber constrictor*), common garter snakes, and common king snakes

(*Lampropeltis getula*). A limited number of bird species, such as western meadowlarks (*Sturnella neglecta*) and Savannah sparrows (*Passerculus sandwich ensis*), nest within ruderal and non-native grassland habitats, but many other species that breed in adjacent riparian habitats will forage in these more open areas. Such species include American kestrels (*Falco sparverius*), red-tailed hawks (*Buteo lineatus*), ash-throated flycatchers (*Myiarchus cinerascens*), northern flickers (*Colaptes auratus*), and western scrub-jays (*Aphelocoma californica*). The burrows of many small mammals found in these habitats, such as California ground squirrels (*Spermophilus beecheyi*), California voles, and Botta's pocket gophers (*Thomomys bottae*) also provide refuge for many of the reptiles described above. Other mammals found in ruderal/non-native grassland habitats include opossums, pallid bats (*Antrozous pallidus*), black-tailed hares (*Lepus californicus*), deer mice, coyotes, striped skunks (*Mephitis mephitis*), and black-tailed deer.

II.B.6. Open water:

Seasonal, perennial, and tidal flows within channels comprise open water habitat. During summer and fall, beds of seasonal streams and high-flow benches in perennial streams are exposed, consisting of dry sediments, sand, and gravel bars. During low tides, mudflats, sediment benches, and channel bottoms can also be exposed in tidal areas.

Open water provides aquatic habitat for the many fish and amphibian species described above in salt marsh, brackish marsh, freshwater wetland, and riparian forest, such as steelhead, chinook salmon, threespine stickleback, Pacific tree frogs, western pond turtles, and muskrats. Waterfowl and wading birds, such as great egrets, mallards, and American coots, use open water habitats for foraging.

II.C. Regulatory Setting

The District is a special purpose governmental agency with jurisdiction and authority generally independent of other local public agencies, including the general-purpose governments, the cities, and the County of Santa Clara. However, District watershed management operations and capital improvement projects are subject to the regulatory oversight of a number of State and Federal government agencies with jurisdiction over local and regional environmental resources.

Below are descriptions of the various agencies whose oversight has significant impacts on District projects and operations and on monitoring requirements that the District often must commit to in the course of carrying out its goals and objectives. These descriptions are excerpted form the "Draft Environmental Impact Report and Stream Maintenance Program Report for the Multi-Year Stream Maintenance Program" dated March 28, 2001. The reader is referred to the original documents for more detailed information.

II.C.1. California Department of Fish and Game (CDFG):

The mission of CDFG is to manage California's diverse fish, wildlife, and plant resources, and the habitats upon which they depend for their ecological values, for their use and enjoyment by the public. Section 1601 of the California Fish and Game Code provides the authority for CDFG to require Streambed Alteration Agreements or negotiate Memoranda of Understanding (MOUs) for routine maintenance activities with governmental agencies if a project proposes to "divert, obstruct, or change the natural flow or bed, channel, or bank of any river, stream or lake" that provides fish or wildlife values. Section 1601 gives CDFG authority to impose restrictions on the District maintenance work in streams in order to protect associated fish and wildlife resources. CDFG staff usually interprets this code to include construction work and grading in perennial and intermittent streams and other types of activities such as management of stream vegetation including the use of herbicides. At times, local CDFG wardens and biologists have interpreted this provision to include flood protection structures such as overflow channels that are adjacent to but not within the original banks of the natural stream.

Section 5650 of the California Fish and Game Code generally prohibits discharge of pollutants or substances that might harm fish, plant life, or bird life. Section 2050 of the Fish and Game Code implements the California Endangered Species Act (see II.D.6 below), which prohibits the import, export, take, possession, purchase, or sale of any endangered or threatened species, unless authorized through an incidental take permit.

II.C.2. California Regional Water Quality Control Boards and State Water Resources Control Board:

The California Regional Water Quality Control Boards (RWQCBs) establish water quality objectives and formulate and adopt Regional Water Quality Control Plans (Basin Plans), including actions required by public and private entities to achieve those objectives. The State Water Resources Control Board (SWRCB) sets general policies and objectives for waters of the State and approves the RWQCB Basin Plans.

The District is within the jurisdiction of two RWQCBs: the San Francisco Bay Region and the Central Coast Region. The San Francisco Bay Region has jurisdiction throughout the San Francisco Bay. Within the District's jurisdiction, this includes all those watersheds that drain to San Francisco Bay, primarily the Guadalupe and Coyote Rivers, but also many other smaller streams and tributaries. The Central Coast RWQCB has jurisdiction along the central coast of California, which in the District's jurisdiction includes all those watersheds that drain to Monterey Bay, primarily the Llagas, Uvas, and Pajaro streams.

The San Francisco Bay Water Quality Control Plan (1995) (also known as the San Francisco Bay Basin Plan) identifies the following beneficial uses of State waters in the Santa Clara Basin: agriculture; cold freshwater habitat (particularly as they support trout and anadromous salmon and steelhead fisheries); ocean, commercial and sport fisheries; estuarine habitat; freshwater replenishment; groundwater recharge; industrial service supply; fish migration; municipal and domestic supply; navigation; preservation of rare and endangered species; recreation; shellfish harvesting; fish spawning; warm freshwater habitat; and wildlife habitat.

The San Francisco Bay Basin Plan contains surface water quality objectives intended to maintain thriving aquatic ecosystems. Objectives are provided for bacteria, bioaccumulation, biostimulatory substances, color, dissolved oxygen, floating material, oil and grease, population and community ecology, pH, salinity, sediment, settable material, suspended material, sulfide, tastes and odors, temperature, toxicity, turbidity, unionized ammonia, specific chemical constituents, constituents of concern to municipal and agricultural water supplies, and radioactivity. Some of these objectives are specific numerical limits, whereas others are narrative descriptions. The San Francisco Bay Basin Plan also includes specific effluent limitations for some pollutants, and more general discharge prohibitions in several water quality areas such as turbidity and toxicity.

The Central Coast Regional Water Quality Control Plan identifies similar beneficial uses for the Pajaro River hydrologic unit as noted above for the San Francisco Bay Region. Likewise, it contains similar water quality objectives. There are specific water quality objectives for the Pajaro River at Llagas Creek, which is within Santa Clara County.

The RWQCBs, through the SWRCB, have jurisdiction over any water, surface or underground, including saline waters, within California (California Water Code section 13050[e]). This jurisdiction extends to all waters of the State and to all waters of the United States (under the Porter-Cologne Act (see II.D.4) and Clean Water Act (CWA, see II.D.3), respectively). The San Francisco RWQCB specifically states that wetlands, marshes, and mudflats are within the definition of State waters.

II.C.3. United States Army Corps of Engineers (Corps):

The Corps works to provide protection of the nation's aquatic environment through the regulation of activities in waters of the United States under the federal Rivers and Harbors Act as well as the CWA. Section 10 of the Rivers and Harbors Act of 1899 (33 USC 401, et seq.) requires permits for any work or structures in navigable waters of the United States, including wetlands within or adjacent to these waters. Both dredging and filling are regulated activities under the act. Navigable waters are defined as those waters that are subject to the ebb and flow of the tide, or are presently, have been, or may be used for transport of interstate or foreign commerce.

The CWA (33 USC 1251-1387; Act of June 30, 1948 as amended) is a broad statute with the goal of maintaining and restoring waters of the United States. Among many provisions for the control of water pollution, the act also requires permits for filling of or discharge of dredged materials to waters of the United States. Section 404 of the CWA establishes a permit program for the discharge of fill or dredged material into waters of the United States. Waters of the United States include navigable waters, interstate waters, and all other waters where the use or degradation or destruction of the waters could affect interstate or foreign commerce, tributaries of any of these waters, and wetlands that meet these criteria or that are adjacent to any of these waters or their tributaries. Additional discussion of the CWA is presented in II.D.3 below.

Federal Executive Order 11990 regarding Protection of Wetlands states that federal agencies should avoid impacts to wetlands, and it calls for a no net loss of wetlands. The Presidential Wetland Policy (1993) and Reaffirmation (1995) includes principles for wetland protection. Those relevant to the District activities are:

- No overall net loss and a long-term goal of increasing the quality and quantity of wetlands;
- Regulatory programs must be efficient, fair, flexible, and predictable, avoid unnecessary impacts on the regulated public, and minimize those effects that cannot be avoided, while providing effective protection for wetlands;
- Partnerships should be expanded and approach wetlands protection and restoration in an ecosystem/watershed context;
- Policies should be based on the best scientific information available; and
- Not all wetlands are of equal value.

Historically, the Corps has required compensatory mitigation for significant losses of wetlands that cannot be avoided. Compensation ratios for replacement habitat have had a significant range.

II.C.4. U.S. Fish and Wildlife Service and National Marine Fisheries Service:

The 1973 Endangered Species Act (ESA), as amended, establishes a broad public and federal interest in identifying, protecting, and providing for the recovery of threatened or endangered species. The U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) are charged with implementing and enforcing the ESA. USFWS has authority over terrestrial and continental aquatic species; NMFS has authority over species that spend all or part of their life cycle at sea, including coho and chinook salmon and steelhead trout. Both agencies are involved in District projects and operations through the provisions of the ESA and several particular sections of the ESA affect the District.

USFWS oversees the implementation of the Migratory Bird Treaty Act of 1918 that prohibits the destruction or possession of individual birds, eggs, or nests in active use without a scientific collecting or special purpose permit from the Service and possibly the California Department of Fish & Game.

II.D. Regulatory Drivers

This section provides summaries of the Federal and State environmental laws and regulations that constitute the most significant drivers in the shaping of current and future environmental monitoring needs at the District. The order in which they appear is arbitrary and does not reflect importance or significance with respect to monitoring activities.

II.D.1. National Environmental Policy Act (NEPA)

The National Environmental Policy Act (NEPA) was enacted in 1969 to reduce the impacts of federal activities on environmental resources by requiring federal agencies to identify, avoid, and mitigate any environmental effects of their actions. The Act applies to any action that requires a federal permit or entitlement, is federally funded, is undertaken by a federal agency, or would occur on federal land. Under NEPA, every federal agency is required to prepare an environmental document that discloses the environmental impacts of its proposed action and discusses the alternatives to, and consequences of, the proposed action for the purpose of public review and agency assessment. If the District activity involves a federal agency in any of the capacities described above, it must comply with NEPA. For example, the Guadalupe River project is a joint project between the US Army Corps of Engineers and the District, and requires NEPA compliance.

II.D.2. California Environmental Quality Act (CEQA)

The California Environmental Quality Act (CEQA) was enacted in 1970 as a system of checks and balances for land-use and management decisions by California and local agencies (CEQA Statues and Guidelines, 1996). Since that time there have been numerous changes and additions to the original Act. These changes reflect both clarifications and reflections of changes in other environmental laws. As NEPA applies to federal actions, CEQA applies to any action that requires a permit or entitlement from a California public agency, is funded or undertaken by a California public agency, or would occur on California public land. CEQA requires any California public agency to perform an Initial Study that identifies the proposed project's environmental impacts and determines whether those impacts are significant. Depending upon the level of impact, the public agency must prepare one of three environmental review documents. If the Initial Study finds no significant impacts, a Negative Declaration can be prepared. If significant impacts are identified, but the project is revised to avoid or mitigate those impacts, then a Mitigated Negative Declaration must be prepared. An Environmental Impact Report must be prepared if the project will result in significant environmental impacts. If a District activity involves a California public agency in any of the capacities described above, it must comply with CEQA. Additionally, the District is considered a local public agency.

Thus, any activities that it authorizes, funds, etc., may be subject to CEQA. In this case, the District would act as the lead agency in the CEQA process. In cases where both NEPA and CEQA are required, a joint document can be prepared if there is agreement by the lead agencies.

NEPA and CEQA processes will continue to be a mandatory assessment process for all District activities that have impacts on the natural environment.

II.D.3. Clean Water Act

Section 402(p) – Stormwater NPDES Program
Section 402(p) requires stormwater permits for industries and for municipalities with populations over 100,000. This program has issued guidance for preparation of permit applications for regulated municipal and industrial stormwater discharges. In addition, it stresses the use of best management practices (BMPs) to minimize or eliminate the contribution of pollutants to stormwater discharges to waters of the United States, including wetlands.

USEPA adopted implementing regulations in 1990. The regulations require permitted dischargers to conduct monitoring to estimate pollutant loads and to evaluate the effectiveness of BMPs.

Along with Santa Clara County, the District is a co-permittee under an NPDES permit issued to the 13 cities within the portion of the County that drains to South San Francisco Bay. In compliance with the permit, the District implements BMPs to prevent stormwater pollution from its own activities (including the use of pesticides and management of corporation yards). The District also participates in the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP).

Section 305(b) and 303(d) – Water Quality Assessments and Impairment List
States are required to report to the USEPA the status of water quality in the State (Section 305(b) water quality assessment), and provide a list of impaired water bodies (Section 303(d) list) every two years. Impaired water bodies are those where water quality standards are not expected to be met after implementation of best available technology controls, which include municipal wastewater treatment plants. Water quality standards include designated uses, any narrative or numeric water quality objectives, and antidegradation, or maintenance of ambient water quality.

Once the water bodies are 303(d) listed, the State is required to determine the amount that the pollutants of concern must be reduced to meet the applicable water quality standard and eliminate beneficial use impairment. This allocation of allowable pollutant discharge from various sources is called a total maximum daily load, or TMDL.

Section 404 Permits (Wetlands)
Section 404 of the Clean Water Act establishes a program to regulate the discharge of dredged or fill material into "waters of the United States," which includes wetlands. Wetlands are among the most biologically diverse and productive systems. The U.S. Fish and Wildlife Service estimates that up to 43% of the threatened and endangered species rely directly or indirectly on wetlands for their survival. In addition, wetlands provide important ecosystem services by buffering against floods and providing natural filtration that improves water quality and decreases the rate and volume of runoff in urban areas (USEPA 1999).

CWA Section 404 is administered by the US Army Corps of Engineers (Corps), with USEPA oversight. Activities in waters of the United States that are regulated under this program include fill for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports), and conversion of wetlands to uplands for farming and forestry. Section

404 requires that impacts to waters of the US as a result of dredge/fill activity will be avoided, minimized, or mitigated.

Regulated activities are controlled by a permit review process. An individual permit is usually required for potentially significant impacts. However, for most discharges that will have only minimal adverse effects, the Corps often grants up-front general permits. These may be issued on a nationwide, regional, or state basis for particular categories of activities (for example, minor road crossings, utility line backfill, and bedding) as a means to expedite the permitting process. Many of the District's maintenance activities fall under the Corps Nationwide Permit Program, such as maintenance of existing flood control facilities; temporary construction, access and dewatering; reshaping existing drainage ditches, and stormwater management facilities. Monitoring activities can be a result of mitigation requirements for a Section 404 permit, but do not themselves require a Section 404 permit.

Section 401 Permits

Section 401 of the Clean Water Act requires that before a federal water permit is issued, the federal agency taking the action must obtain certification that the project will not result in discharges that violate the state's water quality standards. The California State Water Resources Control Board (through its Regional Water Quality Control Boards) is the agency mandated to protect the state's waters. The Regional Board sets the ambient water quality standards that are based on beneficial uses and limit the concentrations of pollutants in a stream.

For the District, this means that projects in which the Army Corps of Engineers is involved also require a state water quality certification from the San Francisco Bay RWQCB. Some of the types of the monitoring projects that fall under the Corps Nationwide Permit Program are eligible for an expedited Section 410 certification process, such as survey activities, moist soil management for wildlife, and fish and wildlife harvesting, enhancement and attraction devices and activities, (SWRCB 2002). Other monitoring activities covered by the Nationwide Permit program may still require a state water quality certification, which requires the Regional Board to prepare a CEQA evaluation. The types of monitoring projects for which a Section 401 permit could be required include stream and wetland restoration activities, as well as numerous flood control maintenance activities, such as maintenance dredging of existing basins, stormwater management facilities, and reshaping existing drainage ditches (SWRCB 2002).

II.D.4. Porter-Cologne Act (California Water Code Division 7: Water Quality)

The California State Water Resources Control Board shares authority with nine Regional Boards for implementation of the Federal Clean Water Act and the Porter-Cologne Act. The Regional Boards address region wide water-quality concerns through a Water Quality Control Plan (Basin Plan), which is updated triennially. The Basin Plan designates beneficial uses of waters of the state and sets narrative and numeric criteria for their protection.

Under the Porter-Cologne Act, anyone proposing to discharge materials that could affect water quality (including discharges of fill or other materials to wetlands) may need to meet project specific "waste discharge requirements" from the RWQCBs. In addition, any applicant for a Section 404 permit under the federal CWA from the U.S. Army Corps of Engineers for an activity which may affect water quality also must apply to the appropriate RWQCB for Water Quality Certification under Section 401 of the CWA. The RWQCBs can waive Water Quality Certification or discharges that will not violate water quality standards.

Generally, projects can be regulated by both the Porter-Cologne Act and the CWA. In the past, RWQCBs have often issued a Water Quality Certification and waived the need for a waste discharge requirement. Recently, the San Francisco RWQCB has required waste discharge requirements for projects that do not fall within the jurisdiction of the Corps under the CWA. The RWQCBs water quality certification must occur prior to the issuance of a Section 404 permit by the Corps.

II.D.5. Federal Endangered Species act

The Federal Endangered Species Act (Federal ESA), originally passed in 1973 (codified in 16 USC 1531, implementing regulations 50 CFR 17), and significant amendments enacted in 1978, 1982, and 1988, were intended to provide comprehensive federal legislation for the protection of threatened and endangered species in the United States. The Act provides for the designation and protection of invertebrates, wildlife, fish, and plant species that are in danger of becoming extinct and provides protection for the habitat on which such species depend (although the habitat provision has just been weakened). The Act defines an endangered species as "any species that is in danger of extinction throughout all or a significant portion of its range". A threatened species is one that is likely to become endangered "within the foreseeable future". The U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) are primarily responsible for implementing the Federal ESA. Significant amendments were enacted in 1978, 1982, and 1988, although the overall framework of the act has remained essentially the same. The main components of the ESA define what species should be protected (Section 3), detail the listing process (Section 4), require federal agencies to consult with USFWS/NMFS when listed species are a concern on projects involving a federal "nexus" (Section 7), prohibit "take" of listed species (Section 9), and provide for permits for exceptions (Section 10). These sections are discussed below.

The ESA prohibits "take" of endangered species (and threatened species where a special rule is not in place). Take has been defined as "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct," and includes habitat modification.

Section 6 of the ESA requires the agencies to determine how threatened or endangered species can be recovered to the point where they no longer require listing under the Act. The USFWS has published recovery plans for several species potentially affected by District activities. NMFS has also initiated recovery planning within the Central California Coast planning area that covers the District.

Section 7 of the ESA directs Federal agencies to use their legal authorities to further the purposes of the Act by carrying out conservation programs for listed species. Section 7 requires consultation with USFWS or NMFS by all federal agencies when any activity they authorize, fund, or carry out may affect a listed species or designated "critical habitat", or when an action is likely to jeopardize proposed species/critical habitat. If the District receives funding from a federal agency (e.g. FEMA, US Army Corps of Engineers) or requires authorization from a federal agency for a project or activity (e.g. 401 Water Quality Certification), AND the project may affect federally listed species or their designated critical habitat, then the lead federal agency must consult with USFWS/NMFS. The USFWS/NMFS then issues a Biological Opinion detailing any "jeopardy or adverse modification" determinations and associated reasonable and prudent alternatives that must be met for the project to be funded/authorized.

For species that are proposed for listing and for which jeopardy is found, Federal agencies are required to confer with the USFWS or NMFS, although the results of such a conference are not legally binding. Because the Corps is a federal agency with permit authority over the District, it is required to consult under Section 7 and comply with any conditions that consultation may place on the federal permit.

Section 9 of the Endangered Species Act prohibits the take of listed animals, with "take" defined as: "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect a federally listed, endangered species of wildlife, or to attempt to engage in any such conduct." Section 9 applies to take of individuals and to take incidental to other activities, such as would occur if an individual were present in an area under construction. Regulations have broadened the definition of take to include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or shelter (50 CFR Section 17.3). Because several protected species occur in the areas of District activities, the District is prohibited any activities that may result in take unless allowed under the terms of a Section 7 consultation or a Section 10(a) permit.

When there is no federal "nexus" involved (e.g. the District is not obtaining a permit or funding from a federal agency and thus cannot seek Section 7 Consultation), the District may apply for an "incidental take" permit under Section 10(a)(1)(B), pursuant to the development of a Habitat Conservation Plan (HCP). The permit is granted only if take is incidental to an otherwise lawful activity, and is minimized and mitigated to the maximum extent practicable. Undertaking an HCP also involves meeting NEPA requirements, as well as internal Section 7 consultation before USFWS/NMFS approves the HCP and issues the incidental take permit. More information on HCPs is provided below in Section III.E.3.

A different type of incidental take permit is needed for scientific collecting or monitoring activities if such activities are likely to result in any harm or other take of listed species. This type of permit is covered under Section 10(a)(1)(A) of the Federal ESA. While the process is much simpler than undertaking an HCP, there may be critical time delays in the granting of such permits. For examples, delays in processing of Section 10(a)(1)(B) permit applications by NMFS since the listing of steelhead (currently federally listed as threatened) have severely hampered various fish survey and monitoring efforts in the Bay Area in the past few years for streams and rivers know or suspected to support steelhead populations.

II.D.6. California Endangered Species Act

California was the first state to prohibit the importation, take, possession and sale of endangered and rare species. The California Endangered Species Act of 1970 defined rare and endangered wildlife species and gave authority to the Fish and Game Commission to identify such animals in California. The 1970 California Species Preservation Act directed California Department of Fish and Game to inventory all threatened fish and wildlife, develop criteria for rare and endangered species and report to the Governor and Legislature every two years on the status of these animals. The California Native Plant Protection Act of 1977 directed the CDFG to preserve, protect and enhance native plants. It gave the Commission the power to designate native plants as endangered or rare and to require permits for collecting, transporting or selling such plants (CDFG website: http://www.dfg.ca.gov/hcpb/species/t_e_spp/tespp.shtml).

In 1984, the California Endangered Species Act replaced the 1970 Endangered Species Act. The definitions and procedures in the Act paralleled those of the Federal Endangered Species Act, creating the state policy "that State agencies should not approve projects as proposed which would jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat essential to the continued existence of those species." Similar to the Federal ESA, State lead agencies are required to consult with CDFG whenever a project might impact a listed species, and 2081 permits may be granted for "incidental take" of listed species under specific conditions. For monitoring activities that will affect listed species, CDFG will require the District to obtain a Scientific Collection Permit as well as a Memorandum of Understanding (MOU), or letter agreement. See below for more details regarding Scientific Collection Permits.

The state has also enacted regulations promoting protection of natural habitats and communities under the Natural Community Conservation Planning (NCCP) Program, a program similar to the federal HCP process. Undertaking an NCCP also involves meeting CEQA requirements. More information on NCCPs and HCPs is provided below in Section III.D.8.

II.D.7. Fish and Wildlife Coordination Act (FWCA)

Fish and Wildlife Coordination Act (FWCA), as amended, seeks to ensure that fish and wildlife resources are given equal consideration with other values during the planning of federal water resource development projects, such as flood control, irrigation, navigation, and hydroelectric power. The Act requires that federal agencies consult with the USFWS, NMFS, and the state fish and wildlife resource agency before undertaking or permitting projects that would control or modify surface water. In addition, a FWCA report may be required that assesses the impacts of the proposed project on fish and wildlife resources, and recommends preservation, mitigation, and enhancement actions for affected resources. FWCA may include addressing concerns that have not been considered under NEPA or the Federal Endangered Species Act.

II.D.8. CDFG Streambed Alteration Agreements

Under Section 1601 of the Fish and Game Code, before any State or local governmental agency or public utility begins a construction project that will: "1) divert, obstruct, or change the natural flow or the bed, channel, or bank of any river, stream, or lake; 2) use materials from a streambed; or 3) result in the disposal or deposition of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into any river, stream, or lake, it must first notify CDFG of the proposed project" (CDFG 2001: web address www.dfg.ca.gov/1600/index.html).

Notification is typically required for any project that will take place in or in the vicinity of a river, stream, lake, or their tributaries. This includes "rivers or streams that flow at least periodically or permanently through a bed or channel with banks that support fish or other aquatic life and watercourses having a surface or subsurface flow that support or have supported riparian vegetation" (CDFG 2001: web address www.dfg.ca.gov/1600/index.html). If CDFG determines that a proposed project may substantially adversely affect existing fish or wildlife resources, a Lake or Streambed Alteration Agreement must be obtained and the proposed project, unless otherwise exempt, will have to be reviewed in accordance with CEQA. As with CWA Section 404 permits, many of the District's activities are regulated under CDFG 1601 permits; for example, vegetation management and stream sediment removal, as part of stream maintenance activities for ongoing flood protection, require a Section 1601 permit. Routine, non-invasive monitoring activities, such as surveying and sampling, do not require a Section 1601 permit.

II.D.9. Migratory Bird Treaty Act

The Migratory Bird Treaty Act of 1918 was a landmark in bird conservation. The treaty designated three categories of migratory birds (game birds, insectivorous birds, and other nongame birds) and identified a season for each in which birds could not be taken except for propagating or scientific purposes under permit. The closed season for insectivorous and nongame birds was, with minor exceptions, year-round. The hunting season for migratory game birds was limited to a maximum of 3.5 months. With only a few exceptions, the act made it illegal to collect bird eggs or destroy nests during the breeding season.

The District recognizes the need to comply with provisions of the Act and, in response, has recently developed specific protocols for bird surveying and monitoring (SCVWD 2000-2001).

II.D.10. Scientific Collection Permits

The State of California through the Department of Fish and Game issues Scientific Collection Permits (SCP) for activities in which you will "take, collect, capture, mark or salvage, for scientific, educational, and non-commercial propagation purposes mammals, birds and their nests and eggs, reptiles, amphibians, fishes, and invertebrates" (Fish and Game Code Section 1002 and Title 14 Sections 650 and 670.7). This applies to rare, threatened or endangered plants or manipulation of their habitat as well. A SCP is issued to individuals, not an organization. For the District, many monitoring activities require scientific collecting permits, which are renewable every two years. For example, a SCP is required for monitoring of CEQA-required mitigation if handling of animals is involved.

For fully protected, threatened, endangered and special concern species, a Memorandum of Understanding (MOU), or letter agreement, may also be required in addition to a SCP. A MOU can be issued to an organization. MOUs are needed for any activity that involves protected species; key species that might occur in stream-related habitat within the District and could be affected by stream and riparian-related monitoring include steelhead (South/Central and Central ESUs), chinook, bay checkerspot butterfly, California red-legged frog, foothill yellow-legged frog, western pond turtle, San Francisco garter snake, several species of birds and plants, San Francisco dusky-footed woodrat and salt-marsh harvest mouse (SCVWD Draft EIR and Stream Maintenance Program Report for the Multi-year Stream Maintenance Program, March 28, 2001). The time period covered by each MOU varies. The District can expect a continued need for these permits as part of its monitoring activities in the future.

II.E. District Mission and Ends Policies

The mission of the District is a "healthy, safe and enhanced quality of living in Santa Clara County through watershed stewardship and the comprehensive management of water resources in a practical, cost-effective and environmentally sensitive manner."

The Board of the District has adopted a set of five policies in pursuit of the various aspects and implications of that mission. Of those, the following two policies relate directly to the quality of life in Santa Clara County and to the stewardship of its watersheds:

4. To secure the health, safety, and quality of life in Santa Clara County, the District will carry out a prudent flood management program that reduces the potential for flood damage, balances costs and benefits (including possible environmental restoration and enhancement), and comprehensively addresses the expectations of the community.

5. The District is a steward of the watersheds in Santa Clara County, the streams and the natural resources therein, and will strive to ensure their benefits to the community's quality of life are protected and when appropriate, enhanced or restored. Consistent with the District's primary

> responsibility to provide for public health and safety, water quality, and water supply, the District's approach in flood management and the water utility shall reflect an ongoing commitment to conserving the environment as a priority in the District's mission of comprehensive public service.

Accordingly, the Board of the District has adopted the following directions to the CEO/GM as to the intended results, organizational products, impacts, benefits, outcomes, recipients, and their relative worth (what good for which recipients at what costs):

E-2 There is a healthy and safe environment for residents and visitors.

- 2.1. There is a reliable supply of healthy, clean drinking water.
- 2.2. There is reduced potential for flood damages.
  - 2.2.1. The cost of reducing the potential for flood damages is balanced with benefits (including possible environmental restoration and enhancement).
  - 2.2.2. There is a balance between the contributions of watersheds and streams in providing for public health and safety and in providing protection of natural resource benefits.

E-3 There is enhanced quality of life in Santa Clara County.

- 3.1. Watersheds, streams, and the natural resources therein are protected and when appropriate enhanced or restored.
  - 3.1.1. Healthy creek and bay ecosystems are protected, enhanced, or restored as determined appropriate by the Board.
    - 3.1.1.1. Opportunities to enhance or restore natural resource benefits of streams and watersheds are identified.
    - 3.1.1.2. Mitigation, enhancements or restoration are implemented when determined appropriate by the Board.

In addition to the Ends Policies, District Board adopted a set of Executive Limitations (EL) for the CEO. Executive limitations EL-5.10 and EL-7.10 both state that the CEO shall not:

> "Spend extravagantly, inefficiently, or in ways more costly than necessary."

II.F. District Programs and Projects with Monitoring Components

The following are overviews of the major programs that drive monitoring activities at the District. The specific monitoring required by these programs is negotiated with agencies issuing regulatory permits and in connection with settling legal and regulatory challenges by outside parties. Many of these programs have common and overlapping elements. These programs may have ecological monitoring requirements some of which may also overlap in nature and characteristics. Therefore, coordination and integration of the diverse factors driving monitoring requirements will be necessary to minimize wasted effort and redundancies, and to facilitate synergies and higher efficiencies.

A selection of these factors is listed in ***Table II-2: "Summary of District Programs and Projects with Environmental Monitoring Components"***. The projects and programs that are included are those that either currently have on-going monitoring activities or will have some in the future based on the purpose and nature of the project or program. Not all of the monitoring activities associated with these programs are or will be conducted by the District. Table II-2 is intended to give only a general sense of some of the monitoring-related factors which would need to be accommodated by any programmatic approach to improving the overall effectiveness and efficiency of the District's monitoring activities. The following are descriptions of the fields in Table II-2 to help the reader understand the limitations and applicability of the presented information:

Purpose:	These are statements describing the goal and objectives of the project paraphrased from project documents or from the District's FY2001/02 and 2002/03 Detailed Budget Manual.
Geographic Coverage:	States the location or geographic extent of the project or the areas affected by the project obtained from project documents or inferred from its purpose, goal, and objectives.
Environmental Resources Affected:	The sub-fields in this column correspond to the various habitats described in "***Section II.B. Environmental Setting"*** of this report. The checked sub-fields refer to habitats that are the focus of the project or are likely to be affected by its activities as indicated in the project documents or inferred from the purpose and geographic coverage of the project.
Monitoring Drivers:	Lists key factors that do or are likely to determine the types and quantities of monitoring activities for the project. These would be the sorts of factors that are described or alluded to in "***Section II.C. Regulatory Setting" and "Section II.E. District Mission and Ends Policies"*** of this report. Listed drivers include existing permits, regulatory oversight, CEQA/NEPA documentation, District Ends Policies, legal challenges, stakeholder processes like the SCBWMI, "collaborative efforts," adaptive management teams, technical advisory committees, partnership agreements, participating or sponsoring agencies, etc. The drivers listed are derived from project documents or inferred from the project's purpose, geographic coverage, and affected environmental resources.
Monitoring Focus:	Lists broad categories of environmental indicators that are or will likely be the focus of the monitoring activities associated with the project based on project documents or as inferred from the project's purpose and geographic coverage and corresponding affected environmental resources and monitoring drivers.

Chapter III "Evaluation of the District's Monitoring Activities" will present detailed treatments of the most significant of these programs in terms of their current and future implications on the type and amount of District monitoring activities.

Table II - 2: Summary of Current District Programs and Projects with Environmental Monitoring Components

Program/Project (Project Number)	**Primary Purpose**	**Geographic Coverage**	**Environmental Resources Affected**						**Monitoring Drivers**	**Monitoring Focus**
			TSM	**TBM**	**FW**	**RFW**	**RNG**	**OWH**		
Alamitos Drop Structure (007411)	Monitor passage of salmonids through the Alamitos Drop Structure and Masson Dam fish passage.	Alamitos Drop Structure and Masson Dam						✓	• Court order • Permit requirements • CEQA	• Surface water quality • Fisheries • Stream flow
Calabazas Creek Salt Marsh Mitigation (201017)	Monitoring and managing the 1.7-acre brackish marsh mitigation area.	Calabazas and San Tomas Aquino Creeks from Guadalupe Slough to HWY237.	✓	✓				✓	• Permit requirements	• Vegetation • Wildlife • Sediment
Capital Improvement Program (Multiple project numbers)	Manage and execute the planning, permitting, design and construction of capital projects over the next 15 years.	District wide: 30 FCP 3 WSSP 12 SOSP 9 RWTDP 8 WTP 6 TWTDP	✓	✓	✓	✓	✓	✓	• CEQA/NEPA documentation. • Regulatory oversight. • Legal challenges.	• Vegetation • Wildlife • Fisheries • SRA cover • Groundwater • Surface water • Stream flow • Stream geomorphology
Comprehensive Habitat Conservation Plan (007441)	Address issues associated with the Federal and State Endangered Species Acts	District wide	✓	✓	✓	✓	✓	✓	• District Ends Policies. • Stakeholder processes • Regulatory oversight. • Legal challenges	• Sediment • Vegetation • Wildlife • Fisheries
Coyote Creek Mitigation Monitoring (007432)	Restore self-sustaining riparian forest and wildlife habitat through monitoring and managing mitigation measures.	Coyote Creek FCP reaches 1A, 1B, 2, and 3.	✓	✓	✓	✓		✓	• Permit requirements	• Vegetation • Wildlife • Groundwater • Surface water

BASMAA Bay Area Storm Management Agencies Association
BMP: Best Management Practices
FCP: Flood Control Projects
FW: Freshwater wetlands
OWH: Open water habitat
RFW: Riparian forest and woodlands
RNG: Ruderal/Non-native grasslands.
RWTDP: Raw Water Transmission and Distribution Projects
SFEI San Francisco Estuary Institute
SFRWQCB: San Francisco Regional Water Quality Control Board
SOSP: Source of Supply Projects
SRA: Shaded Riverine Aquatic
SWM: Salt water marsh
SWRCB: State Water Resources Control Board
TBM: Tidal brackish marsh
TWTDP: Treated Water Transmission Distribution Projects
WSSP: Watershed and Stream Stewardship Projects
WTP: Water Treatment Projects

Table II – 2: Summary of Current District Programs and Projects with Environmental Monitoring Components (Continued)

Program/Project (Project Number)	**Primary Purpose**	**Geographic Coverage**	**Environmental Resources Affected**						**Monitoring Drivers**	**Monitoring Focus**
			TSM	**TBM**	**FW**	**RFW**	**RNG**	**OWH**		
Coyote Creek Mitigation Monitoring (007432)	Monitor and manage saltwater harvest mouse habitat and open water habitat.	Coyote Creek Reach 1A	✓					✓	• Permit requirements	• Soil • Water • Wildlife • Vegetation
Downtown Guadalupe Mitigation and Monitoring (MM) Adaptive Management (604102)	Pursue MM Measurable Objectives through modifications to mitigation, design, operation, maintenance, and/or monitoring procedures over the next 100 years.	Guadalupe River from I-880 to I-280			✓	✓		✓	• Dispute Resolution Memorandum. • Stakeholder processes. • Adaptive Management Team. • Legal challenges • Regulatory permits	• Surface water quality • Fisheries • Stream flow • Stream geomorphology • Vegetation • SRA cover
District Urban Runoff Program (007711)	Protect beneficial uses of streams by preventing pollution of storm water runoff from District activities.	District wide			✓	✓		✓	• NPDES permit requirements	• Surface water quality • Sediment • BMPs
Fisheries and Aquatic Habitat Collaborative Effort (FAHCE) (920414)	Balance water supply needs with needs of anadromous fisheries resources.	Guadalupe, Coyote, and Stevens Creek Watersheds			✓	✓		✓	• Legal challenges. • CEQA documentation. • Regulatory permits. • District Ends Policies.	• Surface water • Fisheries • Stream flow • Stream geomorphology • Vegetation • SRA cover
Guadalupe Fisheries Management Plan (007412)	Conserve, restore, or preserve the habitat and assemblages of native fish in the Guadalupe watershed.	Guadalupe River Watershed			✓	✓		✓	• Court order • Legal challenges • Regulatory permits	• Surface water quality • Fisheries • Stream flow • Stream geomorphology • SRA cover

BASMAA	**Bay Area Storm Management Agencies Association**	**RNG:**	**Ruderal/Non-native grasslands.**	**SWM:**	**Salt water marsh**
BMP:	**Best Management Practices**	**RWTDP:**	**Raw Water Transmission and Distribution Projects**	**SWRCB:**	**State Water Resources Control Board**
FCP:	**Flood Control Projects**	**SFEI**	**San Francisco Estuary Institute**	**TBM:**	**Tidal brackish marsh**
FW:	**Freshwater wetlands**	**SFRWQCB:**	**San Francisco Regional Water Quality Control Board**	**TWTDP:**	**Treated Water Transmission Distribution Projects**
OWH:	**Open water habitat**	**SOSP:**	**Source of Supply Projects**	**WSSP:**	**Watershed and Stream Stewardship Projects**
RFW:	**Riparian forest and woodlands**	**SRA:**	**Shaded Riverine Aquatic**	**WTP:**	**Water Treatment Projects**

Table II – 2: Summary of Current District Programs and Projects with Environmental Monitoring Components (Continued)

Program/Project (Project Number)	**Primary Purpose**	**Geographic Coverage**	**Environmental Resources Affected**						**Monitoring Drivers**	**Monitoring Focus**
			TSM	**TBM**	**FW**	**RFW**	**RNG**	**OWH**		
Guadalupe Watershed Mercury Study (267541)	Provide for studies to characterize levels and migration of Mercury in Guadalupe River Watershed.	Guadalupe River Watershed	✓	✓	✓			✓	• Regulatory oversight • Stakeholder processes • District Ends Policies • CEQA documentation	• Surface water quality • Stream flow • Sediment characteristics • BMPs
Habitat Enhancement Plan (267532)	Provide plan for District Board objective of restoring or enhancing 100 acres of tidal and/or riparian habitat.	District wide	✓	✓	✓	✓		✓	• District Ends Policies	• Fisheries • Wildlife • Stream geomorphology • Vegetation • SRA cover
Habitat Mitigation Enhancement Sites (007421)	Provide early identification and preliminary planning of mitigation sites for District projects and programs	District wide	✓	✓	✓	✓		✓	• District Ends Policies • Regulatory oversight • Stakeholder processes	• Fisheries • Wildlife • Stream geomorphology • Vegetation • SRA cover
Inter-Agency Urban Runoff Program (627903)	Provide funding to the SCVURPPP for conducting special studies and watershed monitoring activities and public outreach and education programs.	District wide	✓	✓	✓			✓	• NPDES permit requirements	• Surface water quality • Stream flow • Sediment characteristics • BMPs
Palassou Ridge Wetland Management (267534)	Protect special status species through development of wetlands, preparation of management plans and monitoring.	Palassou Ridge Reserve			✓		✓	✓	• District Ends Policies. • CEQA Documentation. • Santa Clara County Open Space Authority. • Nature Conservancy Council.	• Vegetation • Wildlife • Surface water

BASMAA	**Bay Area Storm Management Agencies Association**	**RNG:**	**Ruderal/Non-native grasslands.**	**SWM:**	**Salt water marsh**
BMP:	**Best Management Practices**	**RWTDP:**	**Raw Water Transmission and Distribution Projects**	**SWRCB:**	**State Water Resources Control Board**
FCP:	**Flood Control Projects**	**SFEI**	**San Francisco Estuary Institute**	**TBM:**	**Tidal brackish marsh**
FW:	**Freshwater wetlands**	**SFRWQCB:**	**San Francisco Regional Water Quality Control Board**	**TWTDP:**	**Treated Water Transmission Distribution Projects**
OWH:	**Open water habitat**	**SOSP:**	**Source of Supply Projects**	**WSSP:**	**Watershed and Stream Stewardship Projects**
RFW:	**Riparian forest and woodlands**	**SRA:**	**Shaded Riverine Aquatic**	**WTP:**	**Water Treatment Projects**

Table II – 2: Summary of Current District Programs and Projects with Environmental Monitoring Components (Continued)

Program/Project (Project Number)	**Primary Purpose**	**Geographic Coverage**	**Environmental Resources Affected**						**Monitoring Drivers**	**Monitoring Focus**
			TSM	**TBM**	**FW**	**RFW**	**RNG**	**OWH**		
Regional Board Watershed Management Initiative (627914)	Protect and enhance the watershed, creating a sustainable future for the community and the environment. District participates as a stakeholder.	Santa Clara Basin	✓	✓	✓	✓	✓	✓	• EPA. • SWRCB • SFRWQCB • District Ends Policies • Stakeholder processes	• Vegetation • Wildlife • Fisheries • SRA cover • Groundwater • Surface water • Stream flow • Stream geomorphology • Land use • Hydrology
SF Creek Sediment Study (267542)	Develop & Implement the Total Maximum Daily Load (TMDL) for San Francisquito Creek sediment.	San Francisquito Creek Watershed	✓	✓	✓	✓		✓	• District Ends Policies • NPDES permit requirements • Stakeholder processes	• Surface water quality • Stream geomorphology • Sediment characteristics • BMPs
Stream Maintenance Program	Program: Provide long-term guidance to ensure that routine stream maintenance activities are conducted in an efficient, consistent, environmentally sensitive manner.	District wide	✓	✓	✓	✓	✓	✓	• Program policies • CEQA documentation • Permit requirements • Regulatory oversight • BMPs	• Vegetation • Wildlife • Fisheries • SRA cover • Surface water quality • Stream flow • Stream geomorphology
	Annual Stream Maintenance: To maintain structural integrity and design flow conveyance capacity of streams and canals and ensure appropriate access and fire control.	District wide	✓	✓	✓	✓	✓	✓	• Permit requirements • BMPs	• Wildlife • Vegetation • Fisheries • Surface water quality • Sediment characteristics • BMPs

BASMAA	**Bay Area Storm Management Agencies Association**	RNG:	**Ruderal/Non-native grasslands.**	SWM:	**Salt water marsh**
BMP:	**Best Management Practices**	RWTDP:	**Raw Water Transmission and Distribution Projects**	SWRCB:	**State Water Resources Control Board**
FCP:	**Flood Control Projects**	SFEI	**San Francisco Estuary Institute**	TBM:	**Tidal brackish marsh**
FW:	**Freshwater wetlands**	SFRWQCB:	**San Francisco Regional Water Quality Control Board**	TWTDP:	**Treated Water Transmission Distribution Projects**
OWH:	**Open water habitat**	SOSP:	**Source of Supply Projects**	WSSP:	**Watershed and Stream Stewardship Projects**
RFW:	**Riparian forest and woodlands**	SRA:	**Shaded Riverine Aquatic**	WTP:	**Water Treatment Projects**

Table II – 2: Summary of Current District Programs and Projects with Environmental Monitoring Components (Continued)

Program/Project (Project Number)	**Primary Purpose**	**Geographic Coverage**	**Environmental Resources Affected**						**Monitoring Drivers**	**Monitoring Focus**
			TSM	**TBM**	**FW**	**RFW**	**RNG**	**OWH**		
Stream Resources Inventory & Management Program (007465)	Develop a comprehensive understanding of geological and biological resources within Santa Clara County to support District activities.	Santa Clara County	✓	✓	✓	✓	✓	✓	• District Ends Policies • Capital Improvement Program. • Stream Maintenance Program	• Vegetation • Wildlife • Fisheries • SRA cover • Groundwater • Surface water • Stream flow • Stream Geomorphology
Surface Water Quality Improvement (267543)	Develop & implement projects to protect watersheds & streams by minimizing impacts of pollutants to human health, fish, wildlife and the environment.	District wide	✓	✓	✓	✓		✓	• District Ends Policies	• Sediment characteristics • Surface water quality • Stream flow • Stream geomorphology • Bacteriologic pollution
Trails, Parks & Open Space Planning (267511)	Identify potential open space and trail opportunities, develop partnerships, and complete a plan for developing 70 miles over next 15 years.	Santa Clara County	✓	✓	✓	✓	✓		• District Ends Policies • Partnership agreements • CEQA documentation	• Vegetation • Wildlife • SRA cover • Stream Geomorphology
Vegetation Management Program (Multiple project numbers)	Routine control of obstructing vegetation, and planting and maintenance of re-vegetation and mitigation projects.	District wide	✓	✓	✓	✓	✓		• Permit requirements • Mitigation and Monitoring Plans	• Vegetation. • Wildlife. • SRA cover.
Wetland Vegetation Recovery Study (007431)	Develop an understanding of how wetlands recover following sediment removal projects.	Specific sediment removal sites District wide		✓	✓	✓			• Permit requirements	• Wetland vegetation. • Avian usage.

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III. EVALUATION OF DISTRICT MONITORING ACTIVITIES

This chapter presents the results of this review and evaluation project. In addition to current monitoring activities and commitments at the District, this section will identify and evaluate future monitoring needs anticipated from District projects and operations and from trends and developments in environmental laws, regulations, and monitoring sciences, technologies, and management practices.

For the purposes of this review, "monitoring" refers to all activities associated with the collection, management, analysis, and presentation of in-situ ecological data. These include single-event surveys or observations as well as on-going studies involving multiple data collection events over time. Measuring physicochemical parameters of air, water, or soil, taking periodic aerial photographs to study vegetation characteristics, trapping fish and wildlife for baseline assessments of population density and diversity, or measuring sound levels to evaluate impacts of construction noise on nearby nesting patterns are all examples of what are considered in this review as monitoring activities.

III.A. Active Monitoring Efforts and Commitments (FY2001-2003):

The monitoring activities presented here are associated with the Capital Improvement Program and the Watershed Management operations and do not include monitoring of groundwater resources, treated water operations, or water supply operations.

Based on the definitions in section I.B of this report, monitoring activities at the District occur for purposes that fall primarily in the following broad categories:

a) Compliance with project-specific regulatory requirements, and
b) Special studies for assessing the status and/or trends of environmental resources and indicators to support:
    - The Capital Improvement Program during project planning, design, and construction,
    - Watershed Management Operations,
    - Settlement of legal proceedings related to District activities.

Table III-1 "On-Going District Environmental Monitoring Projects" lists current monitoring activities at the District. For each activity, the table includes the description, lead entities (District units or outside agencies), geographic location or extent, drivers, focus, status, and estimated cost. The table is divided into two main categories: Compliance Projects and Special Studies.

Compliance projects consist of monitoring activities that stem from the implementation of mitigation and monitoring plans, self-monitoring programs, memoranda of understanding (MOUs), or other regulatory requirements for environmental data collection, management of mitigation sites, and/or periodic reporting.

In contrast, Special Studies consist of monitoring activities that are conducted for reasons other than regulatory compliance, like legal settlements, environmental resources surveying and management, or simply for the general enhancement of our knowledge and understanding of the watersheds and stream ecosystems in which the District operates.

District staff engages in additional activities involving field observations of environmental indicators that are not included in Table III-1. Biologists and water quality specialists in the Ecological Services Unit

(ESU) are often called upon to make field observations and provide guidance to on-going District construction or operations activities in accordance with applicable environmental laws, stewardship policies, and/or best management practices. Examples include pre-construction or pre-maintenance surveys for nesting birds or other protected fauna or flora, noise surveys, fish observation and rescue during planned or unplanned dry-backs of streams, etc. Information from these field observations are generally not used beyond the immediate needs of the on-going construction or maintenance activities. Furthermore, observations made during such field consultations are not typically stored, compiled, or later retrieved for analyses to increase knowledge and understanding of environmental systems within the District. Such field observations clearly do not fall under the definition of monitoring activities adopted in this review, and as such are not included in Table III-1or elsewhere in this evaluation report.

On the other hand, the surveys and monitoring that will be conducted before and during the maintenance and construction activities that are covered by the Stream Maintenance Program and related permits are included here and are considered elsewhere in this report. This exception is consistent with our definition for monitoring since the District's commitments include the compilation and annual reporting to the regulatory agencies on these surveys and monitoring activities. Additionally, the resulting information will be used to update the District's GIS maps and databases for the purposes of enhancing our knowledge of the environmental resources and aiding the District's future management decisions that may affect these resources.

The budget estimates included in Table III-1 are based on the District's Fiscal 2001-2003 Detailed Budget Manual and significant budget adjustments made since the approval and publication of the budget in June 2001. For projects in which monitoring activities, as defined in this review, constitute only parts of the overall objectives of a project, the estimates consist of the portion of a project's total budget that can reasonably be attributed to the monitoring components based on the budget breakdown and/or on discussions with the lead District staff.

Table III - 1: On Going District Monitoring Projects

Program/Project (Project Number)	**Description/Primary Purpose**	**Geographic Coverage**	**Entity Conducting the Monitoring or Lead Entity**	**Monitoring Drivers**	**Monitoring Focus/Program**	**Status**	**Estimated Budget**	
							FY01-02	**FY02-03**
					I. REGULATORY COMPLIANCE			
Alamitos Drop Structure (007411)	Monitor passage of salmonids through the Alamitos Drop Structure and Masson Dam fish passage as part of a 5-year program for evaluating fish passage and species composition in the vicinity of these structures.	Alamitos Drop Structure and Masson Dam.	• Ecological Services Unit	• Permit requirements	• Habitat inventory U/S & D/S of structures. • Species compositions U/S & D/S. • Salmonids rearing distribution and density • Upstream and Downstream fish migration • Spawning surveys • Carcass surveys. • Wildlife • Sediment	• The preparatory work and planning effort have been completed. • The District is pursuing the necessary permits to conduct the monitoring, and the project is experiencing significant delays due to on-going negotiations relating to field protocols.	$302,940	$273,256
Calabazas Creek Salt Marsh Mitigation (201017)	Monitoring and managing the 1.7-acre brackish marsh mitigation area.	Calabazas and San Tomas Aquino Creeks from Guadalupe Slough to HWY237.	• Ecological Services Unit	• Permit requirements	• Vegetation	• Reported on annually. • Success criteria have been met. • Approval to discontinue monitoring is being sought from regulatory agencies.	$126,638	$127,593

Table III – 1: On-Going District Environmental Monitoring Projects (Continued)

Program/Project (Project Number)	**Description/Primary Purpose**	**Geographic Coverage**	**Entity Conducting the Monitoring or Lead Entity**	**Monitoring Drivers**	**Monitoring Focus/Program**	**Status**	**Estimated Budget**	
							FY01-02	**FY02-03**
Coyote Creek Mitigation Monitoring (007432)	Restore self-sustaining riparian forest and wildlife habitat through monitoring and managing mitigation measures.	Coyote Creek FCP reaches 1A, 1B, 2, and 3.	• Ecological Services Unit.	• Permit requirements.	• Amphibians and small mammals: Quarterly for the first 5 years, then in the 10th and 15th year, and every 10 yrs thereafter for the life of the project. • Avian and seabirds: Annually until success criteria are achieved, then in the 5th, 10th and 15th year, and every 10 yrs thereafter. • Salt Marsh Harvest Mouse: Every two years until objectives are met, and every 5-10 years thereafter for the life of the project, Reach 1A: • Currently in the 15th year of implementation. • Salt marsh harvest mouse use of mitigation sites in R1A. • Soil salinity twice a year until objectives are met. • Water birds on a monthly basis. • Vegetation monitoring once a year. Standish Dam: • Located in Reach 1A. • District is in negotiations with regulatory agencies to discontinue monitoring. • Groundwater in wells around the dam. Monthly from April through October, and every two months for the rest of the year • Salinity on a monthly basis. • Vegetation once a year. Reach 2: • Amphibians and small mammals. • Avian use on a weekly basis during a monitoring year. • Vegetation monitoring once a year. Reach 3: • May include fisheries (population, spawning gravel, & fish passage) monitoring in the future depending on the nature of the resolution of the status of Standish Dam and corresponding mitigation requirements. • Surface water (temperature, dissolved oxygen, salinity) twice a month from May through October. • Amphibians and small mammals. • Avian use on a weekly basis during a monitoring year. • Vegetation monitoring once a year.	Reach 1A: • The mitigation and monitoring are in their 15th year of implementation. • Success criteria have not been achieved. Standish Dam: • The mitigation and monitoring are in their 15th year of implementation. • On-going. • Negotiations underway to discontinue or significantly later current status. Reach 2: • The mitigation and monitoring are in their 15th year of implementation. • Success criteria have been achieved. Reach 3: • The mitigation and monitoring are in their 5th year of implementation. • Objectives and success criteria have been met.	$472,550	$213,426
SF Creek Sediment Study (267542)	Develop & Implement the Total Maximum Daily Load (TMDL) for San Francisquito Creek sediment.	San Francisquito Creek Watershed	• Countywide Watershed Programs Unit.	• District Ends Policies • NPDES permit requirements • Stakeholder processes	• Surface water quality • Stream geomorphology • Sediment characteristics • BMPs	• Planning efforts underway.	$185,577	$281,153

Table III – 1: On-Going District Environmental Monitoring Projects (Continued)

Program/Project (Project Number)	**Description/Primary Purpose**	**Geographic Coverage**	**Entity Conducting the Monitoring or Lead Entity**	**Monitoring Drivers**	**Monitoring Focus/Program**	**Status**	**Estimated Budget**	
							FY01-02	**FY02-03**
Stream Maintenance Program	Program: To conduct surveys and monitoring best management practices before and during stream maintenance activities, and to carryout a biodiversity-monitoring program.	District wide	• Ecological Services Unit • Vegetation Management Unit	• Program policies • CEQA • Permit requirements • Regulatory oversight • BMPs	• Monitoring associated with Annual Maintenance Projects: o Pre-construction surveys for sensitive wildlife & fish. o Migratory Bird Nest surveys. o Serpentine soil grasslands, shrublands, and woodlands delineation. o Native vertebrates. o Updating GIS maps • Biodiversity Monitoring Program o FY2002-2003 is the first year of implementation o Details and strategies have not been developed o For the purposes of estimates and projections, monitoring to start with will likely focus on the following depending on the plan ultimately adopted: ▪ Annual updating of the Fisheries Habitat Maps ▪ Salt Marsh Harvest Mouse, and Bats, Snowy Plover, Clapper Rail, Least Bell's Vireo, Bay Checkerspot. ▪ Raptor Nest Surveys Salt Marsh Yelowthroat, Alameda Song Sparrow, and Burrowing Owl surveys. ▪ Red-legged Frog, California Tiger Salamander. ▪ Steelhead and Chinook ▪ Coyote Ceanothus, Santa Clara Dudleya, Metclaf Canyon Fewelfower, and Mt. Hamilton Thistle.	• 2001 Sediment Removal Project monitoring completed and required reports submitted. • Planning began for the 2002 stream maintenance projects.	$221,000	$475,000
	Annual Stream Maintenance: Ensure that sediment removal activity is performed in compliance with the water quality monitoring requirements of the WDR issued by the RWQCB, and sediment is characterized, and disposed in accordance with the approved sediment characterization plan	District wide	• Ecological Services Unit • Countywide Watershed Programs Unit • Vegetation Management Unit	• Permit requirements • BMPs	• Sediment Characterization • Surface water quality monitoring • BMPs	• 2001 Sediment Removal Project monitoring completed and required reports submitted. • Planning began for the 2002 stream maintenance projects.	$228,750	$198,750
Vegetation Management Program (Multiple project numbers)	Routine control of obstructing vegetation, and planting and maintenance of re-vegetation and mitigation projects.	District wide	• Vegetation Management Unit	• Permit requirements • Mitigation and Monitoring Plans	• Vegetation. • Wildlife • SRA cover.	• On-going.	$58,300	$60,000

Table III – 1: On-Going District Environmental Monitoring Projects (Continued)

Program/Project (Project Number)	**Description/Primary Purpose**	**Geographic Coverage**	**Entity Conducting the Monitoring or Lead Entity**	**Monitoring Drivers**	**Monitoring Focus/Program**	**Status**	**Estimated Budget**	
							FY01-02	**FY02-03**
Wetland Vegetation Recovery Study (007431)	Develop an understanding of how wetlands recover following sediment removal projects.	Specific sediment removal sites District wide	• Ecological Services Unit	• Permit requirements	• Wetland vegetation. • Avian usage	• The monitoring for the last of a 4-year commitment has been completed. • Annual reports are submitted to regulatory agencies. • The final report is due by June 2002.	$184,219	$118,302
						Regulatory Compliance Subtotal	$1,779,974	$1,747,480
					II. SPECIAL STUDIES			
Guadalupe Watershed Mercury Study (267541)	Provide for studies to characterize levels and migration of Mercury in Guadalupe River Watershed.	Guadalupe River Watershed	• Countywide Watershed Programs Unit.	• Regulatory oversight. • Stakeholder processes • District Ends Policies • CEQA	• Surface water quality • Stream flow • Sediment characteristics • BMPs	• Efforts are underway for early implementationof the Hg TMDL to reduce Mercury loading within the watershed and provide data to help in assessing the costs, efficacy, and net environmental benefits of various sediment removal and stream bank protection techniques.	$456,973	$812,615
Palassou Ridge Wetland Management (267534)	Protect special status species through development of wetlands, preparation of management plans and monitoring.	Palassou Ridge Reserve	• Ecological Services Unit	• District Ends Policies. • CEQA • Santa Clara County Open Space Authority. • National Conservancy Council.	• Vegetation • Wildlife • Fisheries • SRA cover • Surface water	• The project is in its planning stage. • Monitoring activities are not anticipated until FY2002-2003	$8,500	$281,153
Stream Resources Inventory & Management Program (007465)	Winter Raptor Surveys at District Reservoirs. A 5-year program for developing a database on eagle use of the reservoirs to evaluate the impacts of District activities on the bald eagle.	Almaden, Anderson, Calero, Chesbro, Coyote, Guadalupe, Lexington, Pacheco, Stevens Creek, Uvas, and Vasona Reservoirs.	• Ecological Services Unit	• District Ends Policies • Capital Improvement Program. • Stream Maintenance Program	• Bald and golden eagles • Every year beginning in the last two weeks of November and every three weeks thereafter until April 1st.	• The survey is in its last year of a 5-year program. • Data is stored in a spreadsheet maintained by the project manager. • A report on findings and related Endangered Species Act issues is due by June 2002.	$33,480	$0
	Avian Use Surveys at Percolation Ponds. The surveys document baseline conditions to facilitate possible later development of some of the ponds as wetland/endangered species mitigation sites.	Los Capitancillos Ponds, Oka Ponds, Camden Ponds, Noble Ponds, McClellan Pond, Helmsley Pond, Church Street Ponds no. 2 and 3, and Madrone Channel Ponds.	• Ecological Services Unit (ESU)	• District Ends Policies • Capital Improvement Program. • Stream Maintenance Program	• Species and numbers of birds present during breeding season. • Timing and number of juvenile birds produced. • Habitats or areas used within the ponds by the resident species.	• The survey is in its last year of a 5-year program. • Data is stored in a database built and maintained by the ESU. • A final report on the 5-year program is planned for completion by June 2002.	$32,450	$0

Table III – 1: On-Going District Environmental Monitoring Projects (Continued)

Program/Project (Project Number)	**Description/Primary Purpose**	**Geographic Coverage**	**Entity Conducting the Monitoring or Lead Entity**	**Monitoring Drivers**	**Monitoring Focus/Program**	**Status**	**Estimated Budget**	
							FY01-02	**FY02-03**
	Ephemeral Creek Surveys. The surveys document which streams within the District jurisdiction are perennial and which dry up during the summer months.	All streams within the jurisdiction and management authority of the District.	• Ecological Services Unit	• District Ends Policies • Capital Improvement Program. • Stream Maintenance Program	• Presence of water and flow rate in streams during the summer months.	• The surveys have been conducted for the last 4-5 years. • Data is stored in a spreadsheet on the ESU shared directory. • A report on the status and findings of the surveys is due by June 2002.	$24,180	$6,120
	Salinity Study of Tidal Streams in Santa Clara County. The study is to help define maximum annual salinity levels, salinity gradients, and general locations of the extent of saline water intrusion in the tidal streams.	All 16 tidally influenced streams in the County.	• Ecological Services Unit	• District Ends Policies • Capital Improvement Program. • Stream Maintenance Program	• A 5-year program that will end in FY2002-2003 • Salinity of water samples collected at 1000- to 2,000-foot intervals during the course of a single high tide event. • Sampling is conducted in the late summer of each year.	• Annual studies have been conducted for the past four years. The last year of the study is planned for FY02-03. • The latest annual report is for the 1998 study and is dated January 2000. A copy of the report is available from the District library. • Data is stored in a spreadsheet maintained by the project lead. • The next report due in Spring 2002.	$24,420	$65,055
Surface Water Quality Improvement (267543)	Develop & implement projects to protect watersheds & streams by minimizing impacts of pollutants to human health, fish, wildlife and the environment.	District wide	• Countywide Watershed Programs Unit	• District Ends Policies • RWQCB TMDLs. • RWQCB SWAMP. • Stormwater NPDES Permit	• The monitoring program specifics have not been developed yet. Some of the broad categories of indicators and parameters are expected to include: ○ Sediment characteristics ○ Surface water quality ○ Stream flow ○ Stream geomorphology ○ Bacteriologic pollution and risk assessment ○ Trash	• Preparation of a Surface Water Quality Improvement Plan is underway and scheduled for completion in early FY02-03.	$182,477	$479,030
						Special Studies Subtotal	$762,480	$1,643,973
						TOTAL	$2,542,454	$3,391,453

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III.B. Current Collaborative Monitoring

In addition to monitoring pursued by District staff and contractors, the District also collaborates with other agencies to conduct monitoring in Santa Clara Basin streams and watersheds and in San Francisco Bay.

The District has formal, contractual and stakeholder relationships with three multi-agency groups that conduct environmental monitoring:

1. The Santa Clara Valley Urban Runoff Pollution Prevention Program
2. The Santa Clara Basin Watershed Management Initiative
3. The Regional Monitoring Program for Trace Substances

III.B.1. Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP)

SCVURPPP (originally the Santa Clara Valley Non-point Source Pollution Control Program) was organized in response to a 1986 RWQCB Basin Plan amendment. Thirteen cities and towns in the portion of Santa Clara County that drains to San Francisco Bay, the District, and Santa Clara County joined together to characterize non-point source pollution and to investigate ways to control it.

In 1990, the RWQCB issued one of the first stormwater NPDES permits in the U.S. to the District and the other 14 Co-permittees. The permit was reissued in 1995 and 2001.

SCVURPPP's mission is: "To assist in the protection of beneficial uses of receiving waters by preventing pollutants generated from activities in urban service areas from entering runoff to the maximum extent practicable." Each of the Co-permittees implements its own, agency-specific stormwater pollution prevention program. These activities, and the level of implementation, are specified in Performance Standards. Currently, the agencies implement Performance Standards for

- Illicit Connection and Illegal Dumping Elimination Activities
- Industrial/Commercial Discharger Control Program
- Public Streets, Roads, and Highways Operation and Maintenance
- Storm Drain System Operation and Maintenance
- Water Utility Operation and Maintenance
- Planning Procedures
- Construction Inspection.

In addition, the agencies collaborate in various Program-wide efforts, including public education and monitoring,

SCVURPPP is funded jointly by the Co-permittees. Under a memorandum of understanding, the District provides, by annual contribution, approximately 30% of the joint program's cost. A management committee comprised of representatives from each Co-permittee oversees the joint program. District staff chairs this committee.

From 1990 until 1997, the District implemented the joint multi-agency activities, including monitoring. Beginning in 1997, the District retained its role as fiscal agent for the Program, but operations were contracted to a consulting firm, which acts under the direction of the management committee.

From 1990 through 1996, the Program collected continuous flow-composited samples of storm runoff at various locations on South Bay creeks. In 1996, this monitoring was ceased, at the RWQCB's request, and the resources were redirected into a broader, more multifaceted monitoring effort. This included investigation of more effective pollution-prevention methods and participation in the Santa Clara Basin Watershed Management Initiative's assessment of Santa Clara Basin watersheds. From 1998 through 2000, SCVURPPP co-sponsored, in conjunction with the Water Environment Research Foundation, the testing of 20 proposed indicators of the effectiveness of stormwater programs.

SCVURPPP recently submitted to the RWQCB an interim draft 5-year monitoring plan that incorporates and applies the results of the indicators project. SCVURPPP's plan has two distinct emphases:

1. Development and implementation of programmatic measures—to gauge how well Performance Standards are being met and control measures are being implemented, i.e., continuance of implementation monitoring.

2. Development and implementation of environmental measures, to determine if control measures are having the intended effect, and to develop new and improved control measures, i.e., continuance of effectiveness monitoring.

As the District continues to develop its stormwater pollution prevention program, it will continue to work with SCVURPPP to improve programmatic measures of performance. For example, in response to comments from the RWQCB and environmental groups, SCVURPPP convened a task group of staff from the District and local public works departments to investigate ways to improve response to, and documentation of, illegal dumping in District waterways (enforcement of District Ordinance 83-2). SCVURPPP assisted the District and other Co-permittees to implement the group's recommendation to upgrade and integrate reporting procedures. As another example of the District's programmatic monitoring, the permit and Performance Standards require the District to report on pesticide use.

Other District-SCVURPPP collaboration will focus on environmental measurements. When it reissued the stormwater NPDES permit to the District and other Co-permittees, the RWQCB required that these agencies fund various TMDL-related studies. SCVURPPP's 5-year monitoring plan includes specific projects to respond to RWQCB mandates for TMDLs and control measures addressing copper, nickel, mercury, pesticides, PCBs, and dioxins in San Francisco Bay and sediment in Santa Clara Basin creeks. Successful pursuit of this work by SCVURPPP (funded at 30% by the District) will be essential to controlling the District's costs and liability related to these TMDLs.

SCVURPPP participates in a regional monitoring strategy coordinated by the Bay Area Stormwater Management Agencies Association (BASMAA). BASMAA's monitoring committee provides a venue for review, coordination, and annual planning of monitoring carried out by its member agencies. In addition, in August 2001, BASMAA signed an MOU with the Bay Area Dischargers' Association (BADA) and the RWQCB to prepare and implement a 5-year plan to coordinate stormwater and wastewater dischargers' support for the RWQCB's TMDL program. This effort was subsequently dubbed the "Clean Estuary Program."

SCVURPPP's 5-year plan also includes, as part of its extensive support for the Santa Clara Basin Watershed Management Initiative (see below), an integrated pilot assessment of the Coyote Creek watershed. This assessment builds on the work conducted in 1999 for the Stormwater Environmental Indicators Demonstration Project. SCVURPPP has also compiled an inventory of studies of Santa Clara streams and metadata for the Baylands. Both of these documents have been useful to District staff.

III.B.2. Santa Clara Basin Watershed Management Initiative (SCBWMI)

In April 1996, the USEPA, the State Water Resources Control Board (SWRCB) and the RWQCB initiated the SCBWMI. These regulatory agencies recognized that, up to that time, issues affecting watersheds have been addressed by a "patchwork" of separate regulatory actions. There was a need to coordinate regulatory activities on a basinwide scale.

The regulatory agencies invited various interested parties (stakeholders) to discuss their interest in watershed management and how to begin planning watershed use and protection. Current stakeholders include the California Department of Fish and Game, the US Army Corps of Engineers, the Santa Clara Valley Transportation Authority, the cities of Cupertino, Palo Alto, Sunnyvale, Santa Clara and San Jose, the San Jose/Silicon Valley Chamber of Commerce, the Home Builders Association of Northern California, the Santa Clara County Farm Bureau, the Santa Clara Cattlemen Association, the Santa Clara Audubon Society, the Silicon Valley Toxics Coalition, the League of Women Voters, and various other public agencies, business interests, and civic and environmental organizations. The District has participated in this Core Group, and various SCBWMI workgroups, since their inception. Currently, meetings of the Core Group are held in District facilities, and District staff provides leadership and support to specific workgroups.

During 1998 and 1999, SCBWMI stakeholders developed a framework for assessing Santa Clara Basin watersheds and for determining if beneficial uses were being met using existing data. The District funded and contracted for an assessment of the San Franciscquito Creek, Guadalupe River, and Upper Penitencia Creek watersheds using this framework. Results are currently under review by the SCBWMI and District staff.

In addition, the District is supporting development of the SCBWMI's Action Plan, scheduled for completion in late 2002.

In addition to assessing watersheds and developing a watershed management plan, the SCBWMI also provides a forum for discussion and common action around regulatory issues in the Santa Clara Basin. For example, stakeholders in an SCBWMI TMDL Working Group successfully developed proposed site-specific objectives for copper and nickel in South San Francisco Bay and an action plan for assuring that, as the human population continues to grow, these pollutants will not affect South Bay ecology. Another SCBWMI working group has been established to provide stakeholder input for the mercury TMDL in the Guadalupe watershed. The SCBWMI Watershed Assessment Subgroup reviews and coordinates stream assessment, monitoring and restoration efforts by various stakeholders, including the District and SCVURPPP.

III.B.3. Regional Monitoring Program for Trace Substances (RMP)

Seventy-seven public and private organizations that discharge treated wastewater, cooling water, or urban runoff, or are involved in dredging activities, pay for the RMP. SCVURPPP pays about $140,000 of the $2.5 million annual program budget; the District's share (around 30%) is about $42,000. The nonprofit San Francisco Estuary Institute (SFEI) operates the RMP under the direction of Regional Board staff. As a stormwater discharger, the District is currently represented on the RMP

Steering Committee by staff from the Fairfield-Suisun Sewer District and on the RMP Technical Review Committee by staff from the Alameda County Clean Water Program. A senior manager at the District currently sits on SFEI's Board of Directors.

The RMP was created in 1993 as dischargers, hit with increasing requirements to monitor Bay waters individually, agreed to RWQCB requests to fund the costs of a joint program. Sampling of water and sediment at 24 stations, spaced along the Bay from the mouth of Coyote Creek up into the Delta, began in 1993. As documented in annual program reports, the effort successfully characterized concentrations and spatial trends of heavy metals and priority organic pollutants in the Bay.

Characterization of changes over time has proven more difficult. Despite order-of-magnitude decreases in metals concentrations in municipal effluent since the 1980s, enriched Bay sediments, Delta inflow, nonpoint sources, and random variability in samples have confounded efforts to show any resulting decrease in the concentrations of most pollutants of concern.

In 1997, the SFEI and Regional Board staff began a review of the RMP and subsequently proposed a significant expansion in its objectives and scope. In early 2000 SCVURPPP and BASMAA expressed concern that the proposed expansion was too broad and unfocused and that the resources dischargers were providing to the RMP should support the Regional development of TMDLs.

An article in SFEI's 1999 *Pulse of the Estuary* report (published in 2001) emphasizes development of pollutant mass balances, identification of pollutant effects, and the search for heretofore unidentified pollutants.

III.B.4. Current Costs

SCVURPPP is funded jointly by the Co-permittees. Under a memorandum of understanding, the District provides, by annual contribution, approximately 30% of the joint program's cost.

From SCVURPPP's FY 02-03 Budget Summary:

	Total	District Share	District Cost
Fees RWQCB/RMP	$166,000	x30%	$49,800
Monitoring Projects	$605,000	x30%	$181,500
TMDL MOU Resource Fee	$200,000	x30%	$ 60,000
Total District Cost:			$290,000

The above covers the RMP, the Clean Estuaries Program (TMDL MOU), and SCVURPPP's monitoring.

There are indirect costs associated with the participation in the collaborative programs consisting of staff, consultant services, and project support costs. These costs are parts of on-going District projects and are included in the assessment of active monitoring efforts described in section III.A

The RMP and Monitoring Budgets increased 20% in the five (5) years from 1997 to 2002, which is in-line with the average rate of inflation during the same period. For the purposes of cost projections in section III.C, the total District costs for these collaborative programs are assumed to grow at an annual rate of 3.5 for the next 15 years.

III.C. Anticipated Monitoring Needs In The Next 15 Years

The projection of the District's future monitoring costs incorporates two categories of monitoring projects.

The first category comprises projects that the District has already planned or committed: mitigation and monitoring plans associated with (or anticipated for) planned flood management projects, legal and regulatory negotiations currently in progress, and additional mitigation projects already approved by the District Board. The District has relatively little discretion to redesign or adjust monitoring projects in this category.

The second category includes projects that may be anticipated based on our analysis of issues and trends in environmental regulations and the Board's commitment to address these issues and trends, as reflected in the Board's ends policies and other policy statements, such as the direction incorporated in the Clean Safe Creeks and Natural Flood Protection ballot initiative. This category incorporates the commitment to assist the Regional Board to address impaired water bodies within the District's jurisdiction; it also includes efforts that may be necessary to measure the effectiveness of the District's watershed stewardship. The District has considerable discretion to determine the type and extent of monitoring to fulfill these broad objectives.

The costs for each category of projects are estimated and projected over the next 15 years in the sections below. The costs are summed up and presented in Section III.C.3.

III.C.1. First Category—Required Monitoring

For the first category, estimates of monitoring cost for current and committed projects are based on assumptions of the type and extent of monitoring that will be associated with each project. In the main, these projections are extrapolated from detailed estimates previously prepared for the Guadalupe River/Downtown project and the detailed specific requirements negotiated for the District's Stream Maintenance Program, with consideration for differences in size and location of the project.

The District's ability to limit, and possibly reduce, the costs of projects in the first category depends on the outcomes of adaptive management processes, which involve regulatory agencies and other stakeholders (see Section III.D.10.a). Using expert data synthesis, interpretation, and reporting (and employing conceptual models and indicators) District staff may be able to build stakeholder consensus around more limited, targeted monitoring in the later years of these projects. However, the outcomes of the adaptive management processes cannot be predicted in advance. Our projections assume that these projects will continue to require extensive monitoring for many years to come.

Projected cost estimates are based on best professional judgment and should be reviewed with these limitations in mind.

Several of the existing projects described in Section III.A require ongoing monitoring commitments as a result of specific regulatory or legal requirements, and provide examples of how the District will be required to conduct and monitor their projects and activities over the next 15 years. For these ongoing commitments, current monitoring schedules and project budgets were reviewed, when available, to project future monitoring resource needs. Whenever possible, information provided by project managers on timing and extent of monitoring was used to refine the projections. Assumptions for each specific ongoing project are detailed in the following sections.

To anticipate costs for projects whose monitoring components are not well developed yet (e.g. mitigation dependent on outcome of discussions with regulatory agencies, project design not fully developed), the projects activities were lumped into ten generalized project activity categories, and a matrix was developed linking these categories to associated monitoring activities (see Table III-6). A cost estimate for each fiscal year was calculated based on the extent of annual river miles/acreage expected affected, assumptions about the level of effort required to perform various monitoring activities, and the probability that various monitoring activities would be required.

The assumptions used to arrive at the cost projection estimates summarized in Table III-8 are presented for each item in the sections below.

III.C.1.a. Collaborative Monitoring Programs

As stated in Section III.B.4, the RMP and Monitoring Budgets increased 20% in the five (5) years from 1997 to 2002, which is in-line with the normal rate of inflation during the same period. For the purposes of cost projections, the total District costs for these collaborative programs are assumed to grow at an annual rate of 3.5% for the next 15 years.

III.C.1.b. Alamitos Drop Structure

Budget for FY 2003 was provided by the District's "Adopted Detailed Budget." Amounts in subsequent years were assumed to be similar because although certain tasks go offline (e.g. water temp monitoring is only for 2 years) other tasks are scheduled to begin (e.g. spawning surveys).

III.C.1.c. Coyote Creek Mitigation Monitoring

Projections for this project were based on the task and hours estimates for FY 2001-02 and 2002-03, and the following schedule and contract information:

Reach 1A and 2:

- ☐ Currently in the 15th year of implementation
- ☐ Salt marsh harvest mouse use of mitigation sites in R1A. Every two years until objectives are met (objectives not met as of April 2002), and every 5-10 years thereafter for the life of the project.
- ☐ Soil salinity twice a year until objectives are met (not yet met as of April 2002)
- ☐ Water birds on a monthly basis. This work is done under contract with the San Francisco Bay Bird Observatory.
- ☐ Vegetation monitoring once a year.

Standish Dam:

- ☐ Located in Reach 1B.
- ☐ District is in negotiations with regulatory agencies to discontinue monitoring.
- ☐ Groundwater in wells around Standish Dam, monthly from April through October, and every two months for the rest of the year.
- ☐ Salinity on a monthly basis.
- ☐ Vegetation once a year

Reach 2:

- ☐ Currently in the 15th year of implementation
- ☐ Amphibians and small mammals. Quarterly for the first 5 years, then in the 10th and 15th year, and every 10 yrs thereafter for the life of the project. The next survey is not due until FY2011-2012.
- ☐ Avian use weekly. $100,000 contract per reach. FY 2002-2003 will be 15th year, then every 10 years for life of project (again in FY2012-13).
- ☐ Vegetation monitoring once a year.

Reach 3:

- ☐ Currently in the 5th year of implementation
- ☐ Fisheries monitoring (population, spawning gravel, & fish passage) may be added to the monitoring program depending on the outcome of negotiations with regulatory agencies regarding the status of Standish Dam.
- ☐ Amphibians and small mammals. Quarterly for the first 5 years, then in the 10th and 15th year, and every 10 yrs thereafter for the life of the project.
- ☐ Water birds and avian use weekly. $100,000 contract per reach. FY 2002-2003 will be 5th year, then again in 10th (FY2007-2008) and 15th years (FY2012-13), and every 10 years after that for life of project.
- ☐ Vegetation monitoring once a year.

III.C.1.d. San Francisquito Creek Sediment Study

The FY 2003-04 budget is an average of 2001-02 and 2002-03 Adopted Detail Budgets. The FY 2004-05 budget is 1/4 of this total because project completion is expected for Sept. 2004.

III.C.1.e. Downtown Guadalupe Mitigation and Monitoring (Guadalupe River Project)

The projections for this project were based on the estimate of annual hours by monitoring indicator and professional expertise in Table 2-5 of the Draft Implementation Plan for the Guadalupe River Project Mitigation and Monitoring Plan (February 2002). The original hours estimates were for calendar year. These were translated info fiscal year for FY 2003-2009, based on the schedule provided in Table 2-1 of the Implementation Plan. FY 2010-2011 were transition years. Budget projections were dependent on whether information existed in the Implementation Plan, or were averages as described for FY 2012 and beyond. Projections after FY 2010/2011 are based on hours averages of last 5 years, unless the last two years had no hours estimates projected in the Implementation Plan. If the last two years were empty, it was assumed this monitoring activity was over. Additionally, for the anadromous fish spawning indicator, the last amount given for FY2010 or FY2011 was used for future projections, assuming that this indicator would continue at relatively the same effort level.

Hours were then totaled by professional expertise, and the following costs per hour were used to estimate budget:

Cost/hr	**Discipline**
$100	Botanist
$90	Data Entry Specialist
$100	Fisheries Biologist

$100	Geomorphologist
$120	Senior Botanist
$120	Senior Botanist/Biologist
$120	Senior Fisheries Biologist
$120	Senior Fisheries Biologist/WQ specialist

The USACE is anticipated to handover to the District 100% of the monitoring responsibility for this project beginning in summer 2004. Therefore, monitoring budget estimates for this project begin during the 2004-2005 fiscal year.

III.C.1.f. Fisheries and Aquatic Habitat Collaborative Effort (FAHCE)

More specific information for each monitoring component is summarized in Table III-2.

Specific monitoring requirements are currently under negotiation as part of a settlement agreement, and are expected to be complete by May 2002. After this, the project will go through a CEQA process, which will further develop the schedule and level of effort for each monitoring activity. This process is anticipated to be complete during summer 2003. Monitoring is projected to begin in the 2003-2004 fiscal year.

Monitoring for FAHCE is described in the Draft FAHCE Anadromous Fisheries Monitoring Program Outline. Elements of FACHE monitoring are listed below along with assumptions used in projecting the level of effort that will be required. The assumptions were developed with limited information. A thorough review of assumptions is strongly advised.

Descriptions refer to total annual effort unless otherwise noted. Staff cost is assumed to be $108 per hour.

Salmonid Population Dynamics:
- ☐ Field activities will require 2 people for 15 survey days per year for each of the three watersheds, or 90 staff days, or 720 staff hours.
- ☐ Data entry and analysis requirements equal 25% of field efforts

Juvenile Salmonid Rearing:
- ☐ Field efforts will require two full-time staff people for 50% of a year, or 2,000 total hours.
- ☐ Data entry and analysis requirements equal 25% of field efforts

Salmonid Spawning Gravel:
- ☐ Field activities will occur every three years beginning in fiscal year 2003-2004
- ☐ Field surveys and mapping of gravel quality will require 10 days for two people in each of three rivers for a total of 60 staff days, or 480 staff hours.
- ☐ Grab samples will require 5 days for two people in each of three rivers for a total of 30 staff days, or 240 staff hours.
- ☐ Data entry and analysis requirements equal 25% of field efforts

Instream Cover:
- ☐ Detailed mapping will require 300 staff hours in fiscal year 2003-2004.
- ☐ Maps will be updated every 5 years requiring 100 hours per update.

- A field reconnaissance will requiring 2 days for each of three river will occur four times annually, or a total of 24 annual staff days, or 192 annual staff hours.
- Data entry and analysis requirements equal 25% of field reconnaissance efforts

Passage Barrier Performance:

- Barrier passage facilities will be reviewed each year requiring three days of staff effort per river, or a total of staff 9 days, or 72 staff hours.
- Monitoring of fish passage will require field observation by 1 person for 20 days on each of three rivers, or 60 staff days, or 480 staff hours.
- Monitoring of fish passage will also require testing and trapping by 2 people for 3 days in each of three rivers, or 18 staff days, or 144 staff hours.
- Data entry and analysis requirements equal 25% of field efforts

Summer Cold Water Pool Management and Multiport Intake Operations for Temperature Management:

- Thermographs will be used on 50 to 100 sites.
- Field time to deploy thermographs and download data will require 2 people for 10 days, 2 times per year, or 40 staff days, or 320 staff hours.
- Data entry and analysis requirements equal 50% of field efforts

Winter Baseflows and Winter Pulsed Flows:

- Ten transects or reaches will be monitored on each river.
- Field efforts will require 2 people for 2 days, 5 times per year on each of three rivers, or 60 staff days, or 480 staff hours.
- Data entry and analysis requirements equal 25% of field efforts

Trap-and-Truck:

- Some of the monitoring requirements in this element are being conducted as previously accounted for under monitoring for Salmonid Population Dynamics and Summer Cold Water Pool Management.
- Additional field effort for monitoring of redd superimposition will require 2 people for 5 days for each of three rivers, or 30 staff days, or 240 staff hours.

Table III - 2: Summary information for the Fisheries and Aquatic Habitat Collaborative Effort (FAHCE) Moniotoring Activities

Project Component	Geographic Coverage	Timeframe/Schedule	Project Specific Activities
General	Guadalupe River, Stevens Creek, and Coyote Creek watersheds	Settlement agreement projected to be finalized May 2002, then go through CEQA process before monitoring is initiated.	
Salmonid population dynamics			• Adult steelhead and Chinook salmon annual spawner escapement (abundance) estimates. • Age-class and sex ratio of spawning adults.
Juvenile salmon rearing			• Measurement of daily instream flow (May to Oct). • Habitat surveys (focused on water depth suitable for juvenile rearing. • Water temperature (0.5 mile intervals within “management zone”. • Juvenile steelhead surveys within representative habitat in wetted reach downstream of each reservoir during October using electrofishing, standard depletion methods.
Salmonid spawning gravel		Once every three years.	• Field surveys to estimate availability of suitable spawning gravel. • Sediment grab samples to characterize spawning gravel quality.
Instream cover		Once every three months (summer?)	• Instream cover habitat mapping
Passage barrier performance	fish passage facilities (fish ladders, step weir pools, culverts, etc)		• Ensure fish passage facilities conform to current CDFG/NMFS design criteria for salmonids. • Field observations to document successful fish passage (radio or acoustical tagging, visual observations, hydroacoustic monitoring, or other suitable techniques).
Summer cold water pool management	reservoirs included in the cold water pool management program (not yet specified, but could include Stevens Creek, Lexington, Vasona, Guadalupe, Almaden, Calero, Anderson and/or Coyote)	April to October	• Vertical water temperature profile near dam outlet for each of the reservoirs included in the cold water pool management program. • Measure hourly water temp released from each reservoir.

Table III – 2: Summary Information for the FAHCE Monitoring Activities (Continued)

Project Component	Geographic Coverage	Timeframe/Schedule	Project Specific Activities
Winter baseflows	Reservoirs and downstream		• Daily streamflow releases from reservoir. • Stage – discharge relationship at variety of transects representing various habitat types – verify 0.8ft minimum depth criteria is being met.
Winter pulsed flows	Reservoirs		• Daily measurement of reservoir inflow. • Daily instream flow releases from reservoir. • Stage – discharge relationships at critical passage locations downstream of reservoir. • Instream flow continuity between reservoir and confluence with SF Bay. • Reservoir storage and water supply available for meeting pulsed flow requirement.
Multiple intake operations for temperature management	Reservoirs included in the cold water pool management program.		• Same as summer cold water pool management: ○ Vertical water temperature profile near dam outlet for each of the reservoirs included in the cold water pool management program. ○ Measure hourly water temp released from each reservoir.
Trap-and-Truck	Trap downstream of reservoirs, truck into upstream tributaries.		• Relocate adult steelhead when spawning areas downstream of reservoirs is considered “fully seeded”. • Adult steelhead escapement, sex ratio and age distribution. • Redd surveys. • Water temperatures downstream of reservoirs, in addition to any trapping/release locations within upstream tributaries. • Condition of adult and juvenile steelhead collected. • Habitat conditions in upstream tributaries.

III.C.1.g. Stream Maintenance Program

The Stream Maintenance Program (SMP) will programmatically consolidate the District's operational and maintenance activities for increased efficiency in project management, implementation, mitigation, and monitoring. The primary maintenance activities addressed by the Stream Maintenance Program are sediment removal, vegetation management, and bank protection. Other minor activities include: trash removal; installation of fences; road and levee repair; drainage grading; structure repair; tree pruning; irrigation; weeding; mitigation site maintenance; removal of obstructions to flow; and ground squirrel and rodent control. The Stream Maintenance Program has already completed a Final Environmental Impact Report and Biological Assessment, and therefore has already defined mitigation and best management practices with monitoring components. Mitigation will include native plant re-vegetation, creation and/or enhancement of wetland or riparian habitat, and in-channel enhancements.

This program is summarized in Table III-3.

The following are the main sections of the program with an anticipated monitoring component, and describe assumptions used to develop budget estimates over the next 15 years:

SMP Compensatory Stream Vegetation and Special Status Species Mitigation:
1. Restoring 30 acres tidal wetland at $2.2M
2. Creating 14 acres of freshwater wetland at $9.4M
3. Preserving up to 1,080 acres of land at $18.9M
4. Controlling 125 acres of giant reed at $5.9M

- ☐ Wetland creation cost (approximately $550K/acre) was based on historical cost of wetland creation projects. This estimated cost includes design, site preparation, installation, maintenance and monitoring. We assumed that 5% of this cost was set aside for monitoring over 10 years.
- ☐ Land preservation was based on an assumed average acquisition cost of $15K/acre. We assumed that 1% of this cost would go toward annual monitoring.
- ☐ A more detailed cost breakdown for the giant reed removal component (*information on the monitoring portion for this activity is incomplete– this component is not currently included in the monitoring projections*).

The Biodiversity Monitoring Program has a budget of $5 million over the next 10 years, so the assumed expenditure for this portion of the project is $500,000 per year for 10 years, beginning in the 2001-2002 fiscal year.

Mitigation for Bank Protection is anticipated to result in approximately 1.5 river miles of mitigation area per year to compensate for hardscaping and a maximum of 0.5 additional river miles per year for the remainder of bank protection projects to be added each year for ten years. Thus, each year monitoring is likely to occur over two new river miles, plus the cumulative total from prior years. The budget estimates are based on the information provided on cost-estimates for restoration of freshwater wetlands as described in the Compensatory Stream Vegetation and Special Status Species Mitigation. *The budget associated with this component is unavailable, and is not currently included in the total projections for this project.*

Additional BMPs requiring monitoring include site assessments for special status plants and animals (BMP 3.1) and nesting birds (BMP 3.2), surveys for serpentine habitat (BMP 3.3), and salvage of native aquatic vertebrates from dewatered channels (BMP 3.7). Budget estimates are based on annual staff hour estimates provided by the Ecological Services Unit for SMP wildlife implementation.

Table III - 3: Summary of Stream Maintenance Program (SMP) Project Activities and Mitigation/Monitoring Commitments

Project Component	Location	Affected River Miles/Acreage	Timeframe	Project Specific Activities	Activity Category
SMP Program Components					
Sediment Removal	Lowland areas, most frequently in engineered/modified channels, will occur anywhere between the levee slopes.	80,000 cubic yards of sediment estimated to be removed from approximately 16 miles of channel annually for 20 years (cumulatively for 60 miles of streams)	SMP and Program EIR use a 20-year planning time frame, regulatory permits are expected to last for 10 years. Average sediment removal project is 10 days.	Mechanically removing sediment deposited within stream channel, using a variety of heavy equipment, loaded into trucks located in channel bottom or top of bank.	• In-channel construction. • Riparian/floodplain construction.
Vegetation Management	Most flood control facilities require some form of vegetation management.	Annually on roughly 4000 acres, with the targeted treatment area = ~2000 acres. Veg mngt on 866 acres in 212 miles of stream channels (120 treated acres); 23 acres on 27 miles of canals (6 treated acres); 3012 acres of uplands (1894 treated acres).	Varies from semi-annually to once every several years. Generally conducted once a year. Typically during dry season (July 1 to Oct 15)	Herbicides are selectively sprayed (not broadcast). In-channel= herbicide and hand removal. Upland= levee or bank top, slopes, benches, maintenance roads – annual grasses or shrubs are typical: mowing (flail mower to reduce fuel loads), disking for fire breaks, herbicides, hand removal, removal of overhanging growth.	• Herbicides and pesticides. • Vegetation management.

Table III – 3: Summary of SMP Project Activities and Mitigation/Monitoring Commitments. (Continued)

Project Component	Location	Affected River Miles/Acreage	Timeframe	Project Specific Activities	Activity Category
Bank Protection	Historically, greater concentration of bank protection occurs in cities and semi-rural foothills of the SC Valley. Approximately 70% in unmodified channels, 30% in modified channels SCVWD estimates 30-50 work sites annually.	1 linear mile of streambank repaired annually; 20 of 1650 miles of bank in jurisdiction will be modified, 10 miles of this with hardscaping over 20 years	20 years, beginning 2002; Typically implemented during dry season (June 15 – Oct 15) and typically takes 10 days to complete.	To repair and prevent erosion – installation of hard structures (rock blankets, concrete, sack concrete, gabions); soft structures (willow brush mattresses, log crib walls, pole plantings) or a combo of both. No more than 50% will be hardscape. Also includes preventative maintenance for erosion. Use of heavy equipment, sometimes need bypass channel or detention basin. Revegetation of stabilized slopes w/ native vegetation where conditions allow, especially unmodified channels.	• In-channel construction • Riparian/floodplain construction
				Mitigation at 3:1 for hardscaping, 1:1 depending on impact assessment for remainder of 10 miles. Where these are revegetation projects, they will be "regularly inspected" annually for at least a 2-year maintenance period. For bank protection plantings: monitoring shall be conducted annually for at least 5 years or until success criteria are met a minimum of 2 years after irrigation has been removed at the designated planting densities (BMP 2.4).	• Restoration and re-vegetation.

Table III – 3: Summary of SMP Project Activities and Mitigation/Monitoring Commitments. (Continued)

Project Component	Location	Affected River Miles/Acreage	Timeframe	Project Specific Activities	Activity Category
Minor Work				Trash removal, repair and installation of fences/gates, grading and other repairs to restore original contour of access roads and levees, grading small areas without vegetation above streambanks to improve drainage and reduce erosion, repair of structure within same footprint (concrete linings, culverts, pipes), cleaning and minor sediment removal at stream gages, outfalls, culverts, fish ladders, etc.; tree pruning along maintenance roads/fence lines; maintenance of mitigation sites (weeding, pruning, irrigation); removal of flow obstructions within 100 feet of bridges, streamflow gauges, box culverts, outfalls, drop structures; tree pruning/removal when in danger of falling into channel; rodent control w/ traps, smoke bombs and pesticides.	MINOR • In-channel construction. • Riparian/floodplain construction. • Herbicides and pesticides. • Excavation and sediment removal. • Vegetation management.
				1:1 mitigation for work that removes 0.2 acres of wetland and riparian veg. annually. Any individual minor project that will affect more than 0.05 acres of wetland and woody riparian veg is not included.	• Restoration and revegetation.

Table III – 3: Summary of SMP Project Activities and Mitigation/Monitoring Commitments. (Continued)

Project Component	Location	Affected River Miles/Acreage	Timeframe	Project Specific Activities	Activity Category
Mitigation and Best Management Practices					
Compensatory Stream Vegetation and Special Status Species Mitigation	See Table 3 and Figure 3 from Biological Assessment (Sept 2001).	30 acres of tidal wetlands, 14 acres of freshwater wetland in stream channels, approx. 820 – 1080 acres purchased/restored for stream and watershed protection, and 125 acres for Giant Reed Control throughout county.	See Table 3 in BA	Mitigation for impacts due to sediment removal and vegetation management.	• Restoration and re-vegetation.
Best Management Practices #3.1 Minimize Impacts to Special-Status Plants and Animals Item #9	All maintenance work sites			"if sensitive species are found on the work site during pre-construction surveys, then the project biologist shall conduct additional monitoring of the work site during construction."	
BMP 3.19: Develop a Biodiversity Monitoring Program	District-wide		Complete development of biodiversity monitoring program within 1 year of the permits (for SMP) being issued.	Monitoring of special status species and habitats (see BMP 3.19 table for list of species).	
BMP 2.4 Success Criteria for Bank Protection Plantings	See bank protection monitoring requirement of 5 years for plantings.				

III.C.1.h. Capital Improvement Program

The District will be implementing many new capital improvement projects through its Flood Protection and Stream Stewardship Program over the next 15 years. This Program includes the following seven funds, Lower Peninsula Watershed Fund, West Valley Watershed Fund, Guadalupe Watershed Fund, Coyote Watershed Fund, Uvas/Llagas Watershed Fund, Clean Safe Creek and Natural Flood Protection (Measure B) Fund, and the Watershed and Stream Stewardship Fund. Project activities, locations, and schedules within the first six funds[1] were summarized in Table III-5 and were primarily based on information available within the 2002 – 2003 Capital Improvement Plan (Plan) (August 2001). The total number of river miles/acreage affected by the project was then estimated using location descriptions/maps available in the Plan and the station distances provided in the SCVWD Maps of Flood Control Facilities and Limits of 1% Flooding, also known as the "yellow book" (June 1993).

Activities associated with the types of projects listed above (see Table III-6) for specific project information) that may prompt monitoring activities include, but are not limited to, widening and excavation of channels; construction, improvement, and setback of levees and floodwalls; construction and improvement of culverts; removal or improvement of bridges; installation of erosion control measures; bypass channel construction; construction of in-channel sediment control structures; planting and maintenance of native plant species; removal of non-native invasive plant species; creation and/or restoration of tidal and/or riparian habitat; and construction of new trails.

Project activities were combined into the following ten possible activity categories:

- In-channel construction
- Riparian/floodplain construction
- Excavation and sediment removal
- Trail and open space enhancement
- Herbicides and pesticides
- Restoration and revegetation
- Spill response
- Property Acquisition
- Flow regulation
- Vegetation management

These projects represent the majority of new work anticipated to come on line within the next 10 – 15 years, and each will most likely require some environmental monitoring to be performed, either in direct conjunction with the project (e.g. monitoring of revegetation after bank stabilization), or as a result of possible mitigation requirements.

In order to anticipate the level of effort associated with monitoring for capital projects, likely monitoring activities were associated with each of 10 project activities, as presented in Table III-6. These monitoring activities are based on current regulatory requirements typically associated with these project activities.

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[1] The three projects in the Watershed and Stream Stewardship Fund encompass the mitigation component for projects that have already been summarized, and have already been accounted for.

A database was developed to assist with budget projections for CIP projects, which have well defined scopes of work but have yet to define specific mitigation and/or monitoring commitments, as have been done for the SMP and FAHCE project. Project cost estimates were based on river miles/acres affected, project activity and associated monitoring activities as defined in Table III-6, an assumed level of effort per mile/acre per year for various monitoring activities, and an assumed hourly labor rate, multiplied by a probability factor that monitoring would be required (see Figure III-1). These parameters, along with available information on the start dates for CIP projects (summarized in Table III-5), were used to project budgets for each fiscal year. The total for all CIP projects is shown as a component of Table III-8.

General notes for input of information from Table III-5 into the projections database:

- Projects determined to be solely for planning or study purposes were not included in the budget projections database.
- Start fiscal year was based on completion of construction. If construction was completed in June, the monitoring start year was assumed to be the following fiscal year. If a month was not specified, monitoring was assumed to begin in the year when construction was identified as complete.
- San Francisquito length/acreage included in the database only includes the portion of a project within District jurisdiction.
- Projects where activities would occur at one site (e.g. bridge replacement) were assumed to be equivalent to 1 river mile in the projections database.
- Monitoring year was based on fiscal year (June 30 to July 1).
- Freshwater Wetlands Maintenance Mitigation (SCVWD project # 200420) was the only CIP project defined by affected acreage units (all others are associated with river miles). Cost associated with monitoring per acre has not been completed at this time. Therefore, the total cost for all CIP projects shown in Table III-4e does not include this project.
- See Appendix A for project-specific information entered into the database.
- Current labor/costs associated with each monitoring activity were meant to reflect the field portion of the monitoring effort. Therefore, the following items are not accounted for in the current database projections:
    1. Sample processing
    2. Analysis and report writing
    3. Expenses
    4. Travel
    5. Equipment

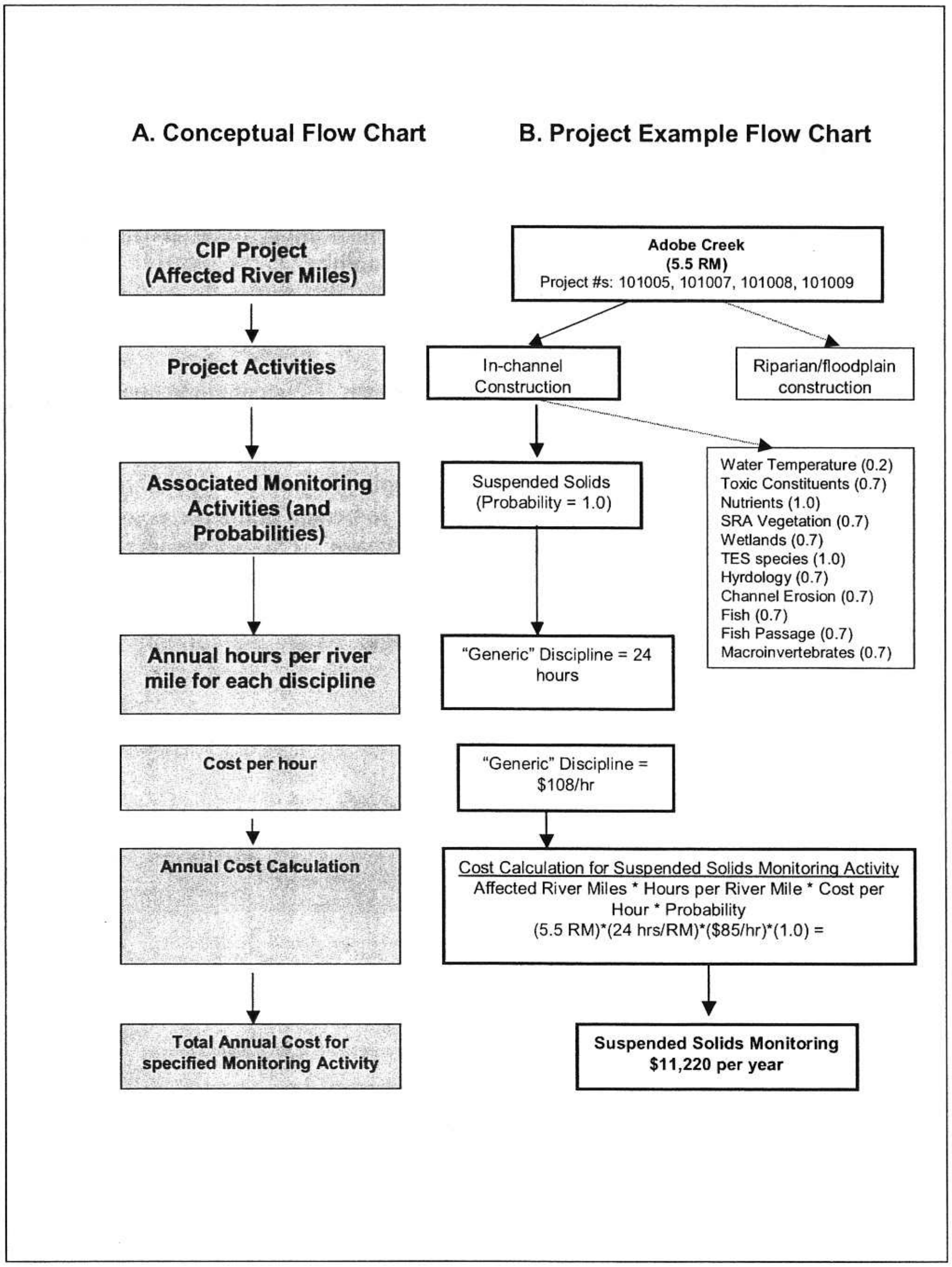
A. Conceptual Flow Chart
B. Project Example Flow Chart
CIP Project (Affected River Miles)
Project Activities
Associated Monitoring Activities (and Probabilities)
Annual hours per river mile for each discipline
Cost per hour
Annual Cost Calculation
Total Annual Cost for specified Monitoring Activity
Adobe Creek
(5.5 RM)
Project #s: 101005, 101007, 101008, 101009
In-channel Construction
Riparian/floodplain construction
Suspended Solids (Probability = 1.0)
Water Temperature (0.2)
Toxic Constituents (0.7)
Nutrients (1.0)
SRA Vegetation (0.7)
Wetlands (0.7)
TES species (1.0)
Hyrdology (0.7)
Channel Erosion (0.7)
Fish (0.7)
Fish Passage (0.7)
Macroinvertebrates (0.7)
"Generic" Discipline = 24 hours
"Generic" Discipline = $108/hr
Cost Calculation for Suspended Solids Monitoring Activity
Affected River Miles * Hours per River Mile * Cost per Hour * Probability
(5.5 RM)*(24 hrs/RM)*($85/hr)*(1.0) =
Suspended Solids Monitoring
$11,220 per year

Figure III - 1: Monitoring Costs Projection Model for CIP Projects

Assumptions for Project Activity and associated Monitoring Activities

- See Appendix B for Project Activity and associated Monitoring Activity relationships.
- A probability was developed to correspond to the likelihood that each monitoring activity would be required, based on project activity. There were three probability categories defined (see Appendix B):
  1. Monitoring typically required (probability = 1)
  2. Monitoring potentially required (probability = 0.7)

3. Monitoring need highly uncertain (probability = 0.2)

Assumptions for annual monitoring hours per river mile:

Table III-4 presents the annual number of hours per river mile to complete each monitoring activity. These were developed using the following assumptions:

- Monitoring for dissolved oxygen, water temperature, toxic constituents, nutrients, and pH assumes 4 person hours (hrs) of sampling monthly.
- Monitoring for suspended solids assumes 4 hrs of sampling every other month.
- Riparian vegetation and SRA vegetation cover assumes 4 sampling events per year, 16 hrs per event.
- Wetlands monitoring assumes 4 events per year, 12 person hours per event.
- Threatened and Endangered species assumes 4 sampling events per year, 12 hrs/event
- Hydrology assumes monthly sampling, 4 person hours per month.
- Channel erosion/deposition assumes 4 sampling events per year, 8 hrs. per event.
- Fish sampling assumes monthly sampling, 16 person hours per event.
- Fish passage assumes 4 sampling events per year, 16 person hours per event.
- Invertebrate monitoring assumes sampling every other month, 16 hrs per event.
- Exotic species and geomorphology are placeholders for monitoring activities that the District may want to incorporate into a future model. They are currently not used for the existing budget estimates for CIP projects.

(Note: Assumptions for monitoring hours per acre have not been developed yet.)

Table III - 4: Monitoring Hours Per Discipline

ID	Monitoring_Activity_Name	Discipline_ID	#_hours/ river_mile	#_hours/acre
1	dissolved oxygen	1	48	0
2	suspended solids (turbidity/TSS)	1	24	0
3	water temperature	1	48	0
4	toxic constituents	1	48	0
5	Nutrients	1	48	0
6	pH	1	48	0
7	riparian vegetation	1	64	0
8	SRA vegetation cover	1	64	0
9	Wetlands	1	48	0
10	Threatened and Endangered species	1	48	0
11	Hydrology	1	48	0
12	channel erosion/deposition	1	32	0
13	Fish	1	192	0
14	fish passage	1	64	0
15	macroinvertebrates	1	96	0
16	exotic species	1	0	0
17	Geomorphology	1	0	0

Assumptions for cost per hour for each discipline area:

- The database has been designed to accommodate different hourly costs associated with various professional areas of expertise (e.g. geomorphology, vegetation, fisheries, and wildlife).
- Currently the database contains only one "generic" discipline.
- The cost per hour for this discipline was assumed to be $108.

In order to anticipate the level of effort associated with monitoring for these capital projects, likely monitoring activities were associated with each of the 10 project activities, as presented in Table III-6. These monitoring activities are based on current regulatory requirements typically associated with these activities.

Table III - 5: Summary of Capital Improvement Projects Used in the 15-year Monitoring Costs Projection Estimates

Project	Location	Station Distance (1000 ft)[2]	Timeframe	Activities	Activity Categories[3]
Capital Improvement Projects (Project Number)					
Adobe Creek (101005, 101007, 101008, 101009)	El Camino Real–Rhus Ridge (urban)	250+00–540+00 (5.5 miles)	Initiation: September 1998 Design: 2002–2005 Construction: 2003–2007 Completion: October 2007	• Erosion control/bank stabilization measures. • Channel modifications to improve sediment transport and improve fish passage. • Floodplain modification. • Bridge and culvert replacement. • Culvert installation.	• In-channel construction. • Riparian/floodplain construction.
Matadero/Barron Creeks Remediation (102109)	Palo Alto Flood Basin–Foothill Expressway (urban)	150+00–300+00 and 0–170+00 (6.0 miles)	Initiation: March 1999 Planning: 2002 Design: 2002–2003 Construction: 2003–2008 Completion: March 2008	• Bridge improvement. • Channel modifications. • Increase floodwalls. • Construct bypass channel.	• In-channel construction. • Riparian/floodplain construction.
Permanente Creek Planning Study (102401)	SF Bay–Foothill Expressway (tidally influenced/urban)	0–380+00 (10.0 miles)	Initiation: January 1998 Planning: 2002–2004 Design: 2004–2008 Completion: June 2008	• Planning study, environmental review, prepare design plans and specs.	• Planning.
San Francisquito Creek Planning Study (102804)	SF Bay–Searsville Dam (tidally influenced/ urban)	0–463+00 (>9.0[4] miles)	Initiation: July 2000 Planning: 2004–2006 Design: 2006–2007 Completion: June 2007	• Planning study, environmental review, prepare design plans and specs.	• Planning.
San Francisquito Creek Levee Restoration (102806)	Downstream of Hwy 101 (tidally influenced)	0–90+00 (1.7 miles)	Initiation: October 2000 Planning: 2002 Design: 2002 Construction: 2003 Completion: March 2003	• Raise levees and floodwalls. • Construction of floodwalls.	• Riparian/floodplain construction.

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[2] *RM estimates are based upon the SCVWD 1% flooding maps.*

[3] *Where actions will be implemented based upon a study or investigation that has not yet been completed, activity categories have been associated based on best professional judgment and included in the Activity Category column.*

[4] *Remaining portion of San Francisquito is outside District jurisdiction and not included on maps*

Table III – 5: Summary of Capital Improvement Projects Used in the 15-year Monitoring Costs Projection Estimates (Continued)

Project	Location	Station Distance (1000 ft)[5]	Timeframe	Activities	Activity Categories[6]
Stevens Creek Drop Structure Modifications (102901)	Hwy 85 (urban)	One site	Initiation: August 2000 Planning: 2002 Design: 2002 Construction: FY 2003 Completion: December 2002	• Relocate stream gauge. • Modify drop structure to improve fish passage.	• In-channel construction.
Freshwater Wetlands Maintenance Mitigation (200420)	Los Capitancillos Pond (urban)	3 acres.	Initiation: April 2000 Planning: 2002 Design: 2002 Construction: FY 2003 Completion: December 2002	• Wetland creation.	• Restoration and re-vegetation.
Calabazas Creek Revegetation (201013)	Lawrence Expressway to Miller (urban)	290+00–400+00 (2.0 miles)	Initiation: June 1998 Construction: 2002–2004 Completion: December 2003	• Re-vegetation.	• Restoration and re-vegetation.
Calabazas Creek, Bollinger Bridge Reconstruction (201015)	Bollinger Bridge (urban)	One site.	Initiation: August 2000 Planning: 2002 Design: 2002 Construction: 2003 Completion: September 2003	• Enlargement of culvert. • Removal of abandoned bridge. • Re-vegetation. • Erosion control.	• In-channel construction. • Riparian/floodplain construction. • Restoration and re-vegetation.
Calabazas Creek, Comer Debris Basin Study (201016)	Comer Debris Basin (rural)	One site.	Initiation: August 2000 Planning: FY 2002–2003 Completion: December 2002	• Prepare feasibility study.	• Study.
San Tomas Creek Repairs (201905)	Monroe Street–Williams Road (urban)	225+00–430+00 (4 miles)	Planning: 2002–2003 Design: 2003–2004 Construction: 2005–2006 Completion: December 2006	• Repair reinforced box culvert. • Maintain flood management facility.	• Riparian/floodplain construction.
Guadalupe River (301511)	Union Pacific RR –Hwy 880 (urban)	262+45–580+00 (6 miles)	Initiation: 2000 Planning: 2002 Design: 2002–2003 Construction: 2003–2007 Completion: June 2007	• Investigate flood capacity, sedimentation, and maintenance problems. • Design, acquire permits for, and implement recommended actions.	• Study. • In-channel construction. • Riparian/floodplain construction.

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[5] *RM estimates are based upon the SCVWD 1% flooding maps.*

[6] *Where actions will be implemented based upon a study or investigation that has not yet been completed, activity categories have been associated based on best professional judgment and included in the Activity Category column.*

Table III – 5: Summary of Capital Improvement Projects Used in the 15-year Monitoring Costs Projection Estimates (Continued)

Project	Location	Station Distance (1000 ft)[5]	Timeframe	Activities	Activity Categories[6]
Guadalupe River Downtown (301513, 301514, 301515, 301516, 301517)	Hwy 880–Hwy 280 (urban)	580+00–710+00 (2.5 miles)	Initiation: August 2000 Planning: 2002 Design: 2002–2003 Construction: 2002–2006 Completion: December 2005	• Plan, design, and implement flood protection mitigation. • Plan, design, and implement recreation and trail elements. • Right-of-way acquisition. • Utility relocation. • Bridge construction.	• Trail and open space enhancement. • Riparian/floodplain construction. • Property acquisition.
Guadalupe Creek Restoration (301525)	Almaden Expressway to Masson Dam (urban)	1050+00–1170+00 (2.3 miles)	Initiation: December 1998 Planning: 1998–2001 Construction: summer 2001–December 2001 Completion: July 2002	• Plan, design, and implement restoration project.	• In-channel construction. • Riparian/floodplain construction.
Los Gatos Creek Erosion Repairs (302002)	Kirk-Page Turnout (urban)	One site.	Initiation: October 1997 Construction: FY 2002 Completion: December 2001	• Erosion control measures. • Concrete repair.	• Riparian/floodplain construction.
Los Gatos Creek (302003)	Giligen Property (urban)	One site.	Initiation: January 2001 Planning: 2002 Design: 2002–2003 Construction: FY 2004 Completion: October 2003	• Erosion control measures/bank stabilization. • Investigate and evaluate hydraulic and geotechnical conditions.	• Riparian/floodplain construction.
Randol Creek Flood Risk Study (302902)	Bret Harte Driver to Alamitos Creek (urban)	0–35+00 (0.7 miles)	Initiation: July 2001 Planning: 2002 Completion: June 2002	• Investigate current capacity of creek; topographic surveys, hydraulic model, WSEL profiles.	• Study.
Berryessa Creek (401704)	Lower Penitencia Creek to Calaveras Boulevard (urban)	0–87+00 (1.6 miles)	Initiation: January 1997 Planning: 2002 Design: 2002–2004 Construction: 2003–2005 Completion: October 2004	• Investigate current conditions. • Design, plan, and construct Board-adopted alternative. • Incorporate trails projects where appropriate.	• In-channel construction. • Riparian/floodplain construction. • Trail and open space enhancement.
Calera Creek (401801)	Berryessa Creek to Hwy 680 (urban)	0–65+00 (1.1 miles)	Initiation: January 2001 Planning: 2002–2003 Completion: January 2003	• Reconnaissance study of flood risk.	• Study.
Calera Creek (401802)	At Union Pacific RR (urban)	One site.	Initiation: October 1997 Construction: 2002 Completion: March 2002	• Improve and expand levees. • Construct access bridge. • Replace sack concrete slope protection.	• Riparian/floodplain construction.

Table III – 5: Summary of Capital Improvement Projects Used in the 15-year Monitoring Costs Projection Estimates (Continued)

Project	Location	Station Distance (1000 ft)[5]	Timeframe	Activities	Activity Categories[6]
Coyote Creek (402108)	SF Bay to Montague Expressway (tidally influenced/urban)	250+00–730+00 (9.1 miles)	Initiation: April 1982 Construction: 2002 Completion: June 2002	• Right-of-way acquisition. • Utility relocation. • Bridge reconstruction.	• Riparian/floodplain construction. • Property acquisition.
Coyote Creek Outdoor Classroom (402118)	William Street (urban)	One site.	Initiation: March 1997 Construction: FY 2002 Completion: October 2001	• Stabilizing/re-vegetating bank. • Re-vegetation. • Constructing classroom and viewing deck.	• Riparian/floodplain construction. • Restoration and revegetation.
Coyote Creek (402119)	South Bay Mobile Home Park Floodwall (urban)	One site.	Initiation: March 1997 Construction: FY 2002 Completion: November 2001	• Removal of shotcreted sandbags. • Construction of floodwall.	• Riparian/floodplain construction.
Coyote Creek (402120)	At Rockspring (urban)	One site.	Initiation: March 1997 Planning: 2002–2003 Design: 2004 Construction: 2005–2006 Completion: March 2006	• Identify structural flood protection measures. • Construct levee/floodwall; or • Setback levee.	• Riparian/floodplain construction.
Lower Silver Creek (402601, 402603, 402607, 402608, 402609)	Coyote Creek to Lake Cunningham (urban)	0–245+45 (6.0 miles)	Initiation: January 1997 Planning: 2002 Design: 2002–2004 Construction: 2002–2009 Completion: October 2009	• Acquire right of way. • Construct 100-yr flood protection improvements. • Construct stream improvements.	• In-channel construction. • Riparian/floodplain construction. • Property acquisition.
Silver/Thompson Creeks (402610)	Cunningham Avenue to Aborn Road (reservoir/urban)	245+50–315+40, 0–72+00 (1.4 miles)	Initiation: August 2000 Planning: 2002–2003 Design: 2003 Construction: 2002–2006 Completion: October 2005	• Sediment removal. • Hydrology and operation study of Lake Cunningham. • Planning, design, implementation of improvements to Lake Cunningham.	• Riparian/floodplain construction. • Excavation and sediment removal.
Upper Penitencia Creek (403203, 403204, 403205)	Coyote Creek to Dorel Drive (urban)	0–197+00 (4.2 miles)	Initiation: January 2000 Planning: 2002–2004 Design: 2002–2007 Construction: 2002-2004 and 2007–2010 Completion: June 2010	• Construct bypass channel. • Develop feasibility Report and EIR. • Right of way acquisition. • Utility and bridge relocation. • Incorporate trails projects.	• In-channel construction. • Riparian/floodplain construction. • Property acquisition. • Trail and open space enhancement.

Table III – 5: Summary of Capital Improvement Projects Used in the 15-year Monitoring Costs Projection Estimates (Continued)

Project	Location	Station Distance (1000 ft)[5]	Timeframe	Activities	Activity Categories[6]
Lower Llagas Creek (502801, 502803)	Pajaro River to Buena Vista Avenue (rural)	Llagas: 0–388, W. Llagas: 0– 218, Lions: 0–85, Day: 0–40, N. Morey: 0-15+14, S. Morey: 0–35+18 (14.6 miles)	Initiation: April 1982 Design: 2002 Construction: 2002–2007 Completion: December 2006	• Use oxygen-releasing compounds to cleanup contamination from underground tanks.	• Spill response.
Uvas/Llagas Vegetative Buffer Strips (509001)	Large target area (rural/suburban)	11.8 miles[7].	Initiation: July 2001 Planning: 2002–2003 Completion: March 2005	• Stakeholder coordination. • Land acquisition/easement. • Plan, design, and install vegetative buffer strips. • Monitor buffer strips for maintenance and reductions of contaminants.	• Property acquisition. • Restoration and re-vegetation.
Permanente Creek (26C178)	SF Bay–Foothill Expressway (tidally influenced/urban)	0–380+00 (10.0 miles)	Initiation: July 2008 Construction: 2009–2016 Completion: June 2016	• Flood protection. • Erosion control, bank stabilization. • Environmental restoration. • Recreation enhancement.	• In-channel construction. • Riparian/floodplain construction. • Trail and open space enhancement.
San Francisquito Creek (26C179)	SF Bay–Searsville Dam (tidally influenced/ urban)	0–463+00 (>9.0[8]miles)	Initiation: July 2006 Design: 2006–2010 Completion: June 2010	• Flood protection. • Erosion control, bank stabilization. • Environmental restoration. • Recreation enhancement.	• In-channel construction. • Riparian/floodplain construction. • Trail and open space enhancement.
Sunnyvale East Channel (26C232)	Guadalupe Slough to Hwy 280	0–342+00 (6.5 miles)	Initiation: July 2007 Planning: 2008–2010 Design: 2011–2016 Construction: 2012–2016 Completion: June 2016	• Erosion control and flood control based upon study results.	• In-channel construction. • Riparian/floodplain construction.

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[7] *Along an estimated 47.3 river miles (based on SCVWD 1% flood maps), there will most likely be only a portion of this area that is actually purchased and restored. Therefore, it was assumed that 25% (11.8 mile) would result in actual area to be purchased/restored.*

[88] *Remaining portion of San Francisquito is outside District jurisdiction and not included on maps*

Table III – 5: Summary of Capital Improvement Projects Used in the 15-year Monitoring Costs Projection Estimates (Continued)

Project	Location	Station Distance (1000 ft)^5	Timeframe	Activities	Activity Categories^6
Sunnyvale West Channel (26C233)	Guadalupe Slough to Hwy 101	0–134+00 (2.5 miles)	Initiation: July 2006 Planning: 2007–2008 Design: 2009–2010 Construction: 2011–2016 Completion: June 2012	• Erosion control and flood control based upon study results.	• In-channel construction. • Riparian/floodplain construction.
Calabazas Creek (26C236)	Miller Avenue–Wardell Road	400+00–550+00 (2.8 miles)	Initiation: July 2003 Planning: 2004–2006 Design: 2007–2009 Construction: 2010–2016 Completion: June 2013	• Erosion control and flood control based upon study results.	• In-channel construction. • Riparian/floodplain construction.
Guadalupe River Upper (261731, 261732, 261733, 26C340, 26C341, 26C342, 26C343, 26C344, 26C45, 26C46, 26C47, 26C48, 26C49, 26C50, 26C51, 26C52)	Hwy 280–Blossom Hill Road	712+00–1027+00, Canoa: 0–35, Ross: 0–44+00 (7.5 miles)	Initiation: July 2001 Design: 2002–2011 Construction: 2002–2007, 2012–2016 Completion: June 2016	• Flood protection based upon study results.	• In-channel construction. • Riparian/floodplain construction.
Berryessa Creek (261741, 261742)	Calaveras Blvd–Old Piedmont Rd	0–297+00 (5.6 miles)	Initiation: December 1980 Planning: 2002–2004 Design: 2004–2006 Construction: 2005–2007 Completion: October 2007	• Flood control. • Mitigation. • Enhance stream habitat and fisheries.	• Riparian/floodplain construction. • Restoration and re-vegetation. • In-channel construction.
Coyote Creek (261743)	Montague Expressway–Hwy 280	750+00–1080+00 (6.3 miles)	Initiation: July 2001 Planning: 2002–2008 Design: 2009–2016 Construction: 2012–2016 Completion: June 2016	• Erosion control and flood control based upon study results.	• In-channel construction. • Riparian/floodplain construction.

Table III – 5: Summary of Capital Improvement Projects Used in the 15-year Monitoring Costs Projection Estimates (Continued)

Project	Location	Station Distance (1000 ft)[5]	Timeframe	Activities	Activity Categories[6]
Upper Llagas Creek (261751, 261752)	Buena Vista Rd–Wright Ave	730+00–390+00, E. Little Llagas: 0–121+00, W. Llagas: 48+00–185+00 (11.3 miles)	Initiation: August 2000 Planning: 2002–2003 Design: 2002–2004 Construction: 2003–2007 Completion: August 2007	• 16.6 miles of channel construction for flood control. • Bridge and box culvert installation. • Utility and facility relocation.	• In-channel construction. • Riparian/floodplain construction.

General notes for input of this information into the projections database:

Monitoring year based on fiscal year (June 30 to July 1).

Start fiscal year based on when construction is completed. If construction is completed in June, then monitoring start year was assumed to be the next fiscal year, except if project ends June 2016, where 2016 is the start fiscal year used.

"Planning" includes environmental review, where applicable.
"Design" includes land purchase, where applicable.
"Construction" includes mitigation component, where applicable.

Projects that are solely for planning or study purposes were not included in the monitoring budget projections database

San Francisquito length/acreage included in database only includes the portion of a project within District jurisdiction.

Projects where activities would occur at one site (e.g. bridge replacement) were assumed to be equivalent to 1 river mile in the projections database.

Table III - 6: Matrix of Project Activity Category and Associated Monitoring Type

● = monitoring typically required ○ = monitoring potentially required ? = monitoring needs highly uncertain

	Water Quality						Vegetation			Wildlife	Aquatic								
Activity Category	Dissolved Oxygen	Suspended Solids (turbidity/TSS)	Water Temperature	Toxic Constituents	Nutrients	pH	Riparian vegetation	SRA vegetation cover	Wetlands	Threatened & Endangered species	Hydrology	Channel Erosion/Deposition	Fish	Fish Passage	Macroinvertebrates	Suspended Solids	Toxic Constituents	Water Temperature	SRA Cover
In-channel construction		●	?	○	●			○	○	●	○	○	○	○	○	●	○	?	○
Riparian/floodplain construction		○	●		○		●	○	○	●	○					○		●	○
Excavation and sediment removal	●	●		○	●	●		○	○	●	○	●	○		○	●	○		○
Trail and open space enhancement							○			●									
Herbicides and pesticides				●			○	?		●			○		○		●		?
Restoration and revegetation		○	○				●	●	●	●	○	○		○		○		○	●
Spill response	●			●		●							○		○		●		
Property acquisition										●									
Flow regulation			●	?			?	?	?	●	●	○		○			?	●	?
Vegetation management				○			●	●	●								○		●

III.C.2. Second Category—Discretionary Monitoring

For the second category, the District has more flexibility in defining the extent, focus, and timing of monitoring. For example, the District may decide that a more rudimentary investigation of a problem provides sufficient information to begin corrective actions and that more extensive monitoring should be considered only after the results of first-year actions have been reviewed. (This reverses the assumptions common to projects in the first category, which generally begin with extensive monitoring and anticipate potential reductions in the level of monitoring effort as the project goes on.) The District may also choose to adjust the number of samples, prioritize parameters analyzed, or increase or reduce monitoring frequency to bring projects within budget.

This flexibility lends itself to a global budgeting process for the District's discretionary monitoring program. The District could budget a set annual amount to pursue this category of monitoring, and adopt a set of broad objectives associated with that expenditure. Through an annual process, a set of monitoring projects would be scoped and adjusted to match the available annual budget.

The following sections describe anticipated monitoring activities that fit under this category. Section III.D presents the cost estimates for both categories projected over the next 15 years.

III.C.2.a. Surface Water Quality Improvement Program (SWQIP)

SWQIP is an operating project residing in the Countywide Watershed Programs Unit of the Office of Countywide Watershed Management. It supports the District Ends Police E3.1—"Watersheds, streams, and the natural resources therein are protected and when appropriate enhanced or restored" by implementing "projects that will protect watersheds and streams through minimizing or eliminating the impacts of pollutants to human health, fish and wildlife, and the environment."9

Over the coming years, SWQIP will pursue its goals through the following objectives:

- Develop an understanding of sediment, PCB, pesticides, and bacteriological pollution in District watersheds;
- Coordinate and collaborate with other agencies, stakeholder groups and partnerships;
- Design and implement monitoring and assessment program to assess the status and trends of target pollutants;
- Develop projects aimed at protecting our creeks by reducing pollutants.

This program is in its earliest phases of development and implementation. Specifics and details of the monitoring projects and activities that may prove necessary to support the above objectives are not known at this time. The focus and approach of the monitoring effort will depend completely on the strategy that is eventually adopted to pursue the SWQIP objectives and the data gaps that are found in existing monitoring efforts.

The monitoring activities in the SWQIP may eventually include physio-chemical characterization of stream sediment and water, biological assessments, and stream flow, geomorphology and habitat functions. Given that the SWQIP is driven mostly by the District's Ends Policies and stewardship commitments, the District has considerable flexibility in defining the extent, focus,

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[9] SCVWD, Operating Project: 267453, Detailed Budget Manual for Fiscal 2001-2003.

and timing of monitoring. For the purposes of estimating and projecting cost, Table III-7 is included as an example program for water-quality monitoring, pending completion of the District's SWQIP.

The specific types and extent of sampling are based on the past few years of discussions initiated by Regional Board staff within SCVURPPP, BASMAA, and the RMP regarding information needs to support TMDLs (note that this list excludes the Guadalupe Mercury TMDL, for which a monitoring program has already advanced into preliminary design). The list also responds to Regional Board staff input regarding the statewide Surface Water Assessment and Monitoring Program (SWAMP) and to various discussions (for example, in RMP newsletters and within the SCBWMI) regarding "emerging" pollutants such as PDBEs and trace pharmaceuticals.

This example program, including the rough cost estimates for each monitoring project, is intended to support the concept of a global budget for water-quality monitoring and to illustrate, in rough outline, what might be accomplished for a budget of the magnitude shown.

The SWIQP budgets in fiscal year 2001-2002 and 2002-2003 were $182,477 and $479,030, respectively, for an average of roughly $330,000. For the purposes of the projections in section III.C.3, it is assumed that the District will simply limit its expenditures on the SWQIP related monitoring activities to an annual average of $330,000 over the next 15 years.

Table III - 7: Example Water Quality Monitoring Plan

Sampling Project	Frequency	Locations	Parameters	Drivers	Potential Annual Cost
Embedded stream sediments	Every three years (2x/year for first 2 rounds)	Five urban locations in each of 10 mainstem streams. Adjust/ reduce after reviewing 1st-round data.	Metals (Cu, Ni), Hg, PCBs, CHCs, Se, Dioxins/Furans, PBDEs, PAHs, TOC, other parameters to normalize data and identify enrichment	TMDLs, concern over emerging pollutants	$100,000
Sediments near storm outfalls	2x/year for 3 years, then pause pending BMPs	10/year, rotate among watersheds	Visual, TOC, Oil and Grease	Potential near-field benthic effects	5,000
Water-quality grabs	1x/year	5 selected urban sites (e.g. WQ stations used 91-96).	OP pesticides, emerging soluble pollutants (e.g. pharmaceuticals, additives)	TMDLs, concern about emerging pollutants	15,000
Swimming access	1/5 years	Urban reaches	Map locations with access and estimate frequency of use	Pathogen TMDL	4,000
Continuous sampling	Continuous during summer	5 urban locations in same watershed; rotate among watersheds	Dissolved oxygen, pH, conductivity, temperature	Concern that low D.O. may be a barrier to fish migration	30,000
Geomorphic condition	In connection with flood control and restoration projects	In connection with flood control and restoration projects	Sediment characteristics, pool depths, physical habitat condition	Sediment TMDLs	40,000
Trash	1x/5 years	Urban reaches	Map locations and estimate frequency/amount of trash, photos.	Trash TMDL	4,000
				TOTAL	$198,000

III.C.2.b. Guadalupe Watershed Mercury Study and other TMDL Related Studies

The projections were based on the FY 2002-03 Adopted Detail Budget amount, assuming a continued involvement in identified workgroups and ongoing consultant involvement.

III.C.2.c. Palassou Ridge Wetland Management

Starts FY 2000-2001, Phase 1 for 3.5 years (max $115,000); Phase 2 for 3 additional years (max $60,000). Because this project is small and monitoring will be over soon, it was not considered in the summary of monitoring budgets in Section III.C.3.

III.C.2.d. Special Studies

The phrase refers to monitoring activities that are performed for reasons other than regulatory or legal compliance. Historically, these projects tended to be mostly in the nature of surveys or inventories of environmental resources and features for baseline conditions at specific facilities or within District jurisdictions. Under this category, there are currently roughly four active projects, three of which are scheduled to conclude this year.

The need for environmental inventory and baseline assessments, trend monitoring, effectiveness, or validation monitoring will likely continue indefinitely into the future. The extent and costs of this sort of monitoring is best determined through careful processes for identifying the key management questions that the District needs to answer, developing the appropriate conceptual models and framework with which to answer these questions, and identifying the gaps in the data needed for utilizing the models (see Section III.D and Section IV.A, and the recommendations in chapter VI.).

The cost projections in Section III.C.3 assume that the District will continue this class of projects at about the funding level it has maintained in the Stream Resources Inventory and Management Program over the past four to five years of around $200,000 a year.

III.C.2.e. Mitigation Compliance Backlog

There may be monitoring commitments associated with the District's past capital improvement projects that are not accounted for in our projections because they are unknown at this time. In preparing this report, District staff examined previous reviews of the District's monitoring efforts. Some of these reviews noted instances where mitigation measures were installed in accordance with a project EIR or Negative Declaration, but the specified monitoring of these mitigation measures was not adequately documented.

Prior attempts have been made to identify such commitments, but none have been comprehensive or conclusive enough to include in this report's analyses and forecasts. This present review encountered the same difficulty in capturing and accounting for these commitments as did previous investigators who also found that:

> "...no central source exists of a complete list of all CEQA environmental documents prepared by the District. Neither is there a location where all such documents are housed for easy access. Similarly, a list of all 404 CEO permits and 1601 Streambed Alteration Agreements is not available. These are usually attached to the Project Plans and Specifications reports, which are located in the Flood Control Design Library. Because of this situation it was difficult and time-consuming to review these reports and permits. The Environmental Resources Management Unit (ERMU) has an extensive but incomplete library of CEQA reports. The District Library does not have complete reference list or copies of the reports. A Library printout of cataloged environmental documents listed only a small number of these documents...."

The above quote comes from the most recent systematic assessment of these commitments carried out in a 1998 mitigation compliance study by Mr. Bernie Goldner, who is a former manager of the Environmental Resources Management Unit (recently reconstituted as the Ecological Services Unit).

Mr. Goldner's study consisted of a review of the mitigation and monitoring requirements stipulated in Environmental Impact Reports (EIR), Negative Declarations (ND) prepared by the District and accompanying Department of Fish and Game 1601 Streambed Alteration Agreements and U.S. Corps of Engineers 404 permits, a review of the District's history of mitigation compliance since the late 1970s, an assessment of the degree to which required mitigation measures had been implemented, and recommendations for remedial measures and alternative strategies.

In his report, Mr. Goldner referred to a "Mitigation Compliance Table" he had prepared listing all the CEQA documents he had reviewed. That referenced table was not found in the present review. According to ESU staff however, the information in that table has since been incorporated into a draft mitigation tracking table that has been kept current by ESU up to January 2001. Members of ESU staff interviewed estimate that the draft table captures at best no more than 85-90% of commitments believed outstanding and point out that the table does not include those projects and requirement that are known only to the staff of the Vegetation Management Unit.

Attempts to obtain a listing of the mitigation and monitoring projects and commitments that the Vegetation Management Unit (VMU) is aware of were unsuccessful in the course of the present review. Although the VMU continues to have a significant role in the monitoring of mitigation sites for regulatory compliance purposes, only one staff member is partially assigned to these duties. That single staff member simply did not have the time to research the records and prepare an accurate list of these monitoring commitments given the already overwhelming demands on his time from on-going, more pressing projects.

Additionally, the specific roles and responsibilities of the VMU with respect to regulatory compliance have not been reviewed or updated to keep pace and remain consistent with the various organizational permutations that the District experienced through a number of restructuring events over the past ten years. As a result, VMU has had to adjust to changing missions and priorities largely of its own accord, with regulatory compliance monitoring and reporting tasks receiving lesser and lesser emphasis in their budgeting and resource allocations.

Members of VMU staff interviewed express considerable frustration and concern that the lack of clarity regarding their role in regulatory compliance for mitigation sites, coupled with increasing demands on their time for vegetation management in general, may have resulted in a significant number of mitigation sites falling behind on their monitoring and reporting requirements. That frustration is compounded by staff's estimation that the majority of these sites have clearly achieved their success criteria and are good candidates for regulatory closures if only the District would formulate a strategy, allocate needed resources, and embark on a concerted effort to assess these sites, prepare a final report, and pursue their formal closure with the regulatory agencies.

The 1998 Goldner study also made a number of findings and corresponding recommendations for bringing the District to fuller compliance with its historic mitigation and monitoring commitments. The present review makes no attempt at ascertaining the adequacy of those recommendations or the degree to which they have since been carried out as these tasks are outside the scope of this project. The Regulatory Compliance Unit in Office of Countywide Watershed Management is currently embarking on a project to assess the compliance status of the District mitigation and monitoring commitments and develop corresponding strategies for tracking and pursuing compliance with historic and future commitments as part of an on-going Permit Management Program. It is expected that once completed, the compliance assessment project will likely identify additional monitoring needs that the District must meet in the coming years.

The cost estimates in III.C.3 assume that the District will commit half a person-year to backlog monitoring activities associated with historic mitigation projects.

III.C.3. Summary of Projected Cost Estimates

Table III-8 below presents a compilation of the projected cost estimates for the projects and activities described in Section C. It is worth noting that the projection estimates do not reflect all potential monitoring activities that the District is likely to undertake in the next 15 years, but only those for which enough information is available to make reasonably useful estimates based on applicable precedents and best professional judgment. Some of the anticipated projects and programs that are likely to have environmental monitoring component but are not included in our projections include (the numbers in the parentheses are current District project numbers):

- Comprehensive Habitat Conservation Plan (007441)
- Habitat Enhancement Plan (267532)
- Habitat Mitigation Enhancement Sites (007421)
- Regional Board Watershed Management Initiative (627914)
- Trails, Parks & Open Space Planning (267511)

In addition, there will likely be other projects and programs with environmental monitoring needs and components that the District will initiate in future budget cycles. With that in mind, it is reasonable to characterize the projection estimates in Table III-8 as "optimistic" in the sense that they probably present the lower end of the range of potential District monitoring needs over the next 15 years.

Table III - 8: Summary of Estimated Monitoring Costs for Fiscal Years 2003-2004 (FY 2004) Through 2017-2018 (FY 2018) by Project

Project	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018
First Category—Required Monitoring															
Collaborative Monitoring Programs	$290,000	$290,000	$290,000	$290,000	$290,000	$290,000	$290,000	$290,000	$290,000	$290,000	$290,000	$290,000	$290,000	$290,000	$290,000
Alamitos Drop Structure	$273,256	$273,256	$273,256	$136,628	--	--	--	--	--	--	--	--	--	--	--
Coyote Creek Mitigation Monitoring	$195,301	$130,466	$195,301	$144,021	$299,976	$130,466	$195,301	$130,466	$233,726	$339,816	$195,301	$130,466	$195,301	$130,466	$195,301
San Francisquito Creek Sediment Study	$233,365	$58,341	--	--	--	--	--	--	--	--	--	--	--	--	--
Downtown Guadalupe Mitigation and Monitoring	USACE monitoring	$531,805	$502,645	$538,995	$503,570	$471,695	$460,835	$468,073	$470,302	$470,302	$470,302	$470,302	$470,302	$470,302	$470,302
Operating Projects/Stream Maintenance Program	$1,392,760	$1,392,760	$1,392,760	$1,392,760	$1,392,760	$1,392,760	$1,392,760	$1,392,760	$1,392,760	$892,760	$312,760	$312,760	$312,760	$312,760	$312,760
	Missing giant reed and bank protection mitigation	Missing giant reed and bank protection mitigation	Missing giant reed and bank protection mitigation	Missing giant reed and bank protection mitigation	Missing giant reed and bank protection mitigation	Missing giant reed and bank protection mitigation	Missing giant reed and bank protection mitigation	Missing giant reed and bank protection mitigation	Missing giant reed and bank protection mitigation	Missing giant reed and bank protection mitigation	Missing giant reed and bank protection mitigation	Missing giant reed and bank protection mitigation	Missing giant reed and bank protection mitigation	Missing giant reed and bank protection mitigation	Missing giant reed and bank protection mitigation
FAHCE	$798,120	$668,520	$668,520	$765,720	$679,320	$668,520	$765,720	$668,520	$668,520	$776,520	$668,520	$668,520	$765,720	$668,520	$679,320
Capital Improvement Program (Total)	$1,126,941	$1,832,017	$2,130,641	$2,814,860	$6,260,630	$6,260,630	$6,853,162	$8,242,370	$8,242,370	$8,242,370	$8,242,370	$8,242,370	$10,029,580	$11,673,729	$11,673,729
Required Sub-Total	*$4,309,743*	*$5,177,165*	*$5,453,123*	*$6,082,984*	*$9,426,256*	*$9,214,071*	*$9,957,778*	*$11,192,189*	*$11,297,678*	*$11,011,768*	*$10,179,253*	*$10,114,418*	*$12,063,663*	*$13,545,777*	*$13,621,412*
w/ 3/5% inflation	*$4,309,743*	*$5,358,366*	*$5,841,522*	*$6,744,313*	*$10,816,846*	*$10,943,426*	*$12,240,652*	*$14,239,590*	*$14,876,884*	*$15,007,909*	*$14,358,842*	*$14,766,744*	*$18,229,023*	*$21,185,000*	*$22,048,905*
Second Category—Discretionary Monitoring															
Guadalupe Watershed Mercury Study & Other TMDLs related studies.	$237,040	$237,040	$237,040	$237,040	$237,040	$237,040	$237,040	$237,040	$237,040	$237,040	$237,040	$237,040	$237,040	$237,040	$237,040
SWQIP	$330,000	$330,000	$330,000	$330,000	$330,000	$330,000	$330,000	$330,000	$330,000	$330,000	$330,000	$330,000	$330,000	$330,000	$330,000
Mitigation Monitoring Backlog	$83,200	$83,200	$83,200	$83,200	$83,200	$83,200	$83,200	$83,200	$83,200	$83,200	$83,200	$83,200	$83,200	$83,200	$83,200
Special Studies & Inventories	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000
Discretionary Sub-Total	*$850,240*	*$850,240*	*$850,240*	*$850,240*	*$850,240*	*$850,240*	*$850,240*	*$850,240*	*$850,240*	*$850,240*	*$850,240*	*$850,240*	*$850,240*	*$850,240*	*$850,240*
w/ 3.5% inflation	*$850,240*	*$879,998*	*$910,798*	*$942,676*	*$975,670*	*$1,009,818*	*$1,045,162*	*$1,081,743*	*$1,119,604*	*$1,158,790*	*$1,199,347*	*$1,241,325*	*$1,284,771*	*$1,329,738*	*$1,376,279*
Grand Total (w/inflation)	**$5,159,983**	**$6,238,364**	**$6,752,320**	**$7,686,989**	**$11,792,516**	**$11,953,244**	**$13,285,814**	**$15,321,333**	**$15,996,488**	**$16,166,699**	**$15,558,189**	**$16,008,069**	**$19,513,794**	**$22,514,738**	**$23,425,184**

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III.D. Issues & Trends Affecting the District's Future Environmental Monitoring Programs

Over the next few years, and for the foreseeable future, the District will be required to intensify its monitoring of streams, reservoirs, watersheds, and wetlands. More work in streams, additional mitigation requirements, new concerns over pollutants, and increased regulatory scrutiny will generate new requests for field sampling and observations, chemical and biological analysis, and reporting. The sections that follow briefly summarize each a number of factors that will affect the District's future monitoring activities.

III.D.1. General Trends in the Regulatory Environment

The changing social, economic, legal, and political environment in California and the nation during the past several decades has led to a variety of local, state, and federal regulations affecting land and water management, and has affected the way government agencies and the courts have interpreted the intent of such regulations. Past, present, and future trends in the regulatory drivers that govern land and water use in the Santa Clara Valley have important implications for the District's mitigation and monitoring activities.

Over the last 30 years, the regulatory environment has evolved from an acknowledgement that environmental values should be considered when developing the landscape with some public input into those decisions, to a process by which all stakeholders in a geographic area are involved in identifying the important environmental resources that need to be protected and working collaboratively to determine the most effective way to do that.

Initially there were two broad planning authorities: the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) were enacted in 1970. CEQA has resulted in the Environmental Impact Report (EIR) process, and NEPA resulted in the similar Environmental Impact Statement (EIS) process. These acts codified the process by which environmental effects are required to be documented and negative impacts mitigated for any project that requires a local, state or federal permit. These acts additionally established a process by which the public is required to be notified and provided the opportunity to comment on any project in this process.

Following those initial environmental assessment processes, numerous single-subject regulations were promulgated. Examples of these regulations include the Clean Air Act, enacted in 1970 and amended in 1977; the Endangered Species Act (ESA) in 1973; the Federal Water Pollution Control Act enacted in 1972; the Safe Drinking water Act in1974; and the Clean Water Act (CWA), which focuses on pollutant discharges, in 1977. Similar regulations were developed at the state level in California during this same period.

Additionally, certain industries, such as hydroelectric power and other energy developers faced specific additional licensing processes. For example, the Federal Energy Regulatory Commission's licensing process incorporated multiple environmental analyses into a single permit application, but still did not relieve the developers from having to seek resource-specific permits from resource agencies that required them.

Land developers were required to apply for multiple resource-specific permits; in worst cases, developers ended up in adversarial positions with agencies, resulting in costly permit violations.

Although regulatory processes required some form of public notification and availability of an application for review and comment, access for the public to information about a project was not always easily available from the developer or the agency. Litigation was often the way the public and other non-governmental organizations used to get their voices heard. From a developer's perspective, not only was the permit process time consuming, there were no guarantees one would eventually get the permit. Mitigation costs for the project were expensive, as were the frequent lawsuits.

In the 1980s and 1990s industry began working with regulators to help develop the regulations and find a way to satisfy agency requirements while staying in business. Regulators were pressured by both industry and the environmental community to find a more effective way to manage project-related impacts. Addressing environmental problems on a resource-by-resource, and project-by-project basis was not providing sufficient protection for sensitive resources. This process also did not sufficiently address cumulative effects of multiple projects within a geographic area.

With an increased understanding and focus on ecological functions, regulators are now moving from single project issues to basin-wide geographic areas when considering environmental problems. The scientific basis for landscape-level planning has evolved significantly over the last 10-20 years. In California and nationally, there has been an increasing use of landscape-level permitting, including multi-species and multi-agency habitat conservation plans (HCPs), Natural Community Conservation Plans (NCCPs), Basin-wide plans (e.g., the San Francisco Estuary Process, CALFED, the state Watershed Management Initiative, and HCPs and NCCPs throughout the state).

Along with this emphasis on more integrated ecological approaches and broader planning scales, there is an increasing use of adaptive management. This has also led to more explicit recognition of the dynamics and natural variability of ecosystems, rather than a steady state condition. Agencies are now more willing to embrace a more flexible, science-base to regulations rather than the simplistic, but easy to enforce, "one-size-fits-all" approach. This requires a change from setting single target values or standards for all streams to an approach that identifies the potential or reference condition that is possible in a given stream at a given site and uses knowledge of current and reference conditions to determine what the target for regulation or voluntary restoration might be (i.e., the ecological context of a site in the surrounding landscape affects regulatory requirements).

The required duration of mitigation monitoring has increased from less than a few years to 5 to 10 years, or longer, in most cases. There is also increasing emphasis on more clearly defining goals and objectives and developing more rigorous and/or sophisticated monitoring approaches.

In the Bay Area, many of the current regulatory processes encourage a collaborative process involving all the stakeholders in the project area, including multiple agencies, industry, environmental and other non-governmental organizations (NGOs), tribes and competing industry groups. There is increased value placed on "sound science", often provided by a third party and subjected to peer review.

III.D.2. Impaired Water Bodies and TMDLs

Section 303(d) of the Clean Water Act required the states to submit to USEPA lists of water bodies that do not attain water quality standards. Water quality standards are the beneficial uses established for water bodies and the narrative or numerical criteria established to protect those uses. Beneficial uses are designated by the states; in California, the nine Regional Water Quality Control Boards designate these uses and establish protective criteria. The Clean Water Act further requires the states to prioritize the non-attaining water bodies and to develop TMDLs for each.

A TMDL, short for Total Maximum Daily Load, specifies the maximum amount of a specific pollutant that a waterbody can receive and still meet water quality standards. The TMDL allocates pollutant loadings to point and nonpoint pollutant sources. TMDLs adopted by the states are reviewed and approved by USEPA; a key requirement is that there be reasonable assurance that the load allocations can actually be achieved.

Congress adopted TMDL requirements in 1972. USEPA issued implementing regulations in 1985 and 1992. Among the difficulties associated with implementing the TMDL regulations are:

- Determining loads from non-point sources.
- Assigning load allocations to non-point sources, which may or may not be controllable.
- Complex pollutant dynamics; e.g., exchange of pollutants between water, air, and sediment.
- For bioaccumulative pollutants (such as mercury and PCBs), uncertainty regarding the biochemical pathways which result in the concentration of pollutants within organisms.

Because of these difficulties, although many water bodies are listed as impaired on the 303(d) list, few TMDLs were submitted to USEPA or adopted by the states. This began to change in the last few years in response to citizen lawsuits.

The San Francisco Bay Region RWQCB (Regional Board) has placed San Francisco Bay on the 303(d) list for various toxic pollutants. Recently, the RWQCB has begun to separately list creeks and rivers tributary to the Bay.

When the RWQCB adds a listing for the Bay, or for a tributary that is in the District's jurisdiction, the District is likely to incur significant costs, as well as regulatory liability and (possibly) legal liability.

The RWQCB has authority under California Water Code Section 13267 to require the District to produce "technical or monitoring program reports" which the RWQCB may require in its investigations. The RWQCB has the power to impose administrative civil penalties or to pursue misdemeanor charges in the event of failure to comply. RWQCB staff may also seek to make submittal of various reports a condition for various permits they issue to the District, including the stormwater NPDES permit and Clean Water Act Section 401 permits issued for specific projects.

The following table identifies the RWQCB's schedule for conducting TMDLs in 303(d) listed waters as they may affect the District.

Table III - 9: Schedule for TMDLs Potentially Affecting the District

Adapted from SAN FRANCISCO BAY REGIONAL WATER QUALITY CONTROL BOARD
WATERSHED MANAGEMENT INITIATIVE
INTEGRATED PLAN CHAPTER
January 2001

WATERBODY(S)	POLLUTANT(S)	Completion Date on 1998 303(d) List (✓= started)	Current Projected Completion Date		
			TMDL Report	TMDL with Implementation Plan	Basin Plan Amendment
All San Francisco Bay Segments	Mercury	2003 ✓	June 2000	June 2001	June 2002
South SF Bay	Copper	2003 ✓	Not Applicable	June 2001	June 2002
South SF Bay	Nickel	2003 ✓	Not Applicable	June 2001	June 2002
All SF Bay Segments	PCBs	2008 ✓	June 2002	June 2003	June 2004
SF Bay Urban Creeks (36)	Diazinon	Listed by USEPA ✓	June 2002	June 2003	June 2004
Guadalupe River Watershed: Calero Reservoir Guadalupe Reservoir Alamitos Creek Guadalupe Creek Guadalupe River	Mercury	2003 ✓	June 2003	June 2004	June 2005
San Francisquito Creek	Siltation	2005 ✓	June 2003	June 2004	June 2005
All SF Bay Segments	Diazinon	2005	June 2004	June 2005	June 2006
All SF Bay Segments	Selenium	2010	June 2008	June 2009	June 2010
All SF Bay Segments	Chlordane, DDT, Dieldrin	Listed by USEPA	To be determined	To be determined	To be determined
All SF Bay Segments	Furans	Listed by USEPA	To be determined	To be determined	To be determined
All SF Bay Segments	Dioxins	Listed by USEPA	To be determined	To be determined	To be determined

Current USEPA regulations require that the 303(d) list be updated every two years. In July 2000, USEPA published new rules for the listing of water bodies under 303(d) and for implementing TMDLs (65 FR 43586). The new rules generated so much controversy that Congress prohibited expenditure of funds from the 2001 or 2002 Federal budget to implement the changes.

Consequently, USEPA postponed implementation of the rules for 18 months (to April 30, 2003), and also postponed the update of the 303(d) list from April 2002 until October 2002. In doing so, the agency stated: "Instead of expending resources in lengthy litigation, EPA believes it can speed up the process of putting in place a more workable program, while building a foundation of trust among stakeholders in the basic process for restoring impaired waters" (66 FR 53043).

In the San Francisco Bay Region, the process of listing impaired waters and developing TMDLs has been just as controversial. Among the disputed issues are the adequacy of data the RWQCB used to create 303(d) listings and requests made to various agencies for additional data that RWQCB staff believes is needed to establish TMDLs.

Because 303(d) listing decisions are based on consideration of all "available data," the District's collection and sharing of water-quality data is intimately bound up with its strategy for regulatory compliance. Sites and water bodies where there is little or no data may escape listing and the agencies responsible for them may (at least temporarily) avoid the consequent regulatory and financial burdens. By contrast, agencies that actively collect and publish data may find their water bodies to be the object of additional scrutiny, negative publicity and, possibly, 303(d) listings for one or more pollutants.

Aware of this bias against more "pro-active" agencies, and seeking to act more even-handedly, in 2000 the RWQCB used evidence of elevated diazinon concentrations in a limited number of urban creeks to list all urban creeks tributary to San Francisco Bay as being impaired by that pesticide. This broad-brush approach heightens a related concern: that water bodies may be listed based on extrapolation of a few scattered data points and RWQCB staff speculation regarding the frequency and distribution of pollutant concentrations and their potential effects on biota.

The RWQCB has prepared workplans for the TMDLs listed in Table IV-1. Each TMDL will include the following specific elements:

1. Problem Statement:
   Description of which standards are not being attained, which beneficial uses are impaired, and the nature of the impairment.

2. Numeric Targets: The Desired Future Condition:
   Measurements that will describe protection of the beneficial uses that are impaired, and attainment of standards. They should provide a basis to assess progress towards, or attainment of standards. Numeric targets may be existing, new, or site-specific numeric water quality objectives. Alternatively they may be a quantitative measure that is a surrogate for a narrative water quality objective or a surrogate for a numeric water quality objective that provides a better basis to link sources to the impairment.

3. Source Analysis:
   Amount, timing, and point of origin of pollutants of concern.

4. Linkage Analysis:
   Description of the relationship between numeric target(s) and sources and estimation of the assimilative (loading) capacity of the water body for the pollutant. The loading capacity is the quantitative link between the applicable water quality standard (as interpreted through numeric targets) and the TMDL.

5. TMDL and Allocations:
   The TMDL may be all or part of the loading capacity. The TMDL is then allocated amongst point, nonpoint, and background sources. Allocations may be specific to agencies or persons

(businesses), or generally by source category or sector.

6. Margin of Safety:
   A margin of safety must be incorporated into the TMDL. The margin of safety may be implicit (using conservative assumptions) or explicit (a discrete allocation assigned to the margin of safety).

7. Implementation Plan:
   Actions, responsible parties, and schedules necessary to alleviate the impairment and meet the allowable TMDL and allocations. Identifies enforceable features (e.g. prohibition), and triggers for Regional Board action (e.g. performance standards). May be part of a watershed management plan.

8. Monitoring / Re-evaluation:
   Monitoring strategy to track implementation of actions and elimination of impairment, and, if necessary, consideration of TMDL revisions.

Any TMDL must be approved as a Water Quality Control Plan (Basin Plan) amendment before the TMDL can be implemented through the state. The Regional Board considers and adopts amendments as part of a publicly noticed hearing. Basin Plan amendments adopted by the Regional Board must also be approved by the State Water Resources Control Board and then by the Office of Administrative Law (OAL). The state TMDL adoption process is complete after OAL approval and state transmittal of the TMDL to EPA for approval. Nevertheless, the Regional Board has incorporated some early action requirements into NPDES permits for TMDL listed pollutants. EPA has authority to promulgate its own regulatory actions if it believes that the state process is not meeting the Clean Water Act requirements or is proceeding too slowly.

The District currently supports the Regional Board's TMDL process through contributions to SCVURPPP. SCVURPPP supports the following TMDL-related efforts:

- *Contributions to the RMP:* Some RMP projects are directly related to TMDL development; others produce data or reports that may be cited in TMDL reports. SCVURPPP will contribute $156,000 to the RMP in fiscal year 2002-2003.
- *Contributions to the Clean Estuary Partnership (CEP).* The CEP was formerly known as the "Water Quality Attainment Strategy Program" and the "TMDL MOU." A joint effort by wastewater dischargers (represented by the Bay Area Dischargers' Association) and stormwater dischargers (represented by BASMAA), this project aims to contribute $10,000,000 over five years to expedite development of TMDLs. SCVURPPP's 2002-2003 budget includes $200,000 toward this effort.
- *Monitoring Projects.* In compliance with specific provisions in its 2001 NPDES provisions, SCVURPPP is implementing several studies to provide information that Regional Board staff will use in TMDLs. SCVURPPP's monitoring budget is $605,000 in 2002-2003. This includes, for example, a PCB Action Plan to identify specific sources of PCBs in industrial areas in the City of San Jose.

Significantly (from the District's point of view), most regionally financed efforts have focused on the Bay, rather than on characterizing sources and loads of listed pollutants within watersheds. (There are some exceptions. The RMP's 1996-1999 Estuary Interface Pilot Project examined sediment concentrations in the intertidal zone of the Guadalupe River and Coyote Creek. The SCVURPPP-led joint stormwater agency study of PCBs and mercury characterized concentrations in storm drain sediments.)

The work of the RMP's Sources, Pathways, and Loadings workgroup has focused attention on watershed sources of persistent pollutants in San Francisco Bay. **It is possible that Regional Board staff will request, either as part of TMDL development or TMDL implementation, additional measurement of pollutants in creek sediments.**

For each of the TMDLs currently scheduled by the RWQCB (Table IV-1), the following review provides background, a summary of District work (or work by the SCVURPPP, RMP, or other agencies that the that the District helps support financially), and consideration of what future monitoring the District may want or be required to pursue in support of the TMDL.

In addition, the review considers pollutants that have been raised as the subject of possible future TMDLs or other regulatory action. Some of these pollutants (e.g. trash) are on a "watch list" first established by the RWQCB in December 2001. Others have been noted, by RMP staff and other researchers, as being of potential concern.

III.D.2.a. Copper and Nickel in South San Francisco Bay:

Background: The RWQCB first listed South San Francisco Bay as impaired by copper and nickel because concentrations of these elements frequently exceeded the standards expressed in the SWRCB's 1991 Inland Bays and Estuaries Plan. That plan was invalidated by a 1994 court decision. In 1992, the Santa Clara Valley Nonpoint Source Control Program completed a study of metals loading to San Francisco Bay (Woodward Clyde 1992) and signed an MOU regarding implementation of a Copper Dialogue, which was intended to achieve reductions in copper loads from various sources. In 1996, the Program prepared a Metals Control Measures Plan (Woodward Clyde 1996), which estimated the relative contributions of copper and nickel from point and non-point sources. The principal source of copper in urban runoff was identified as copper-containing brake pads; the principal source of nickel was found to be erosion of soils containing naturally high concentrations of nickel. The plan's control measures were integrated into SCVURPPP's 1997 Urban Runoff Management Plan. In 1998-2000, an extensive study funded by the cities of San Jose, Sunnyvale, and Palo Alto (Tetra Tech 2000), and reviewed by an SCBWMI TMDL Working Group, resulted in revision of South San Francisco Bay water quality objectives for these metals.

Because concentrations in San Francisco Bay do not exceed the new objectives, the Regional Board is removing the listing of copper and nickel for all Bay segments. The achievement of stakeholder and scientific consensus regarding copper and nickel in South San Francisco Bay, developed through an SCBWMI stakeholder process, could provide a model for other TMDLs.

By stakeholder consensus, tasks in the 1992 Copper Dialogue were incorporated into new "Copper/Nickel Control Actions." These tasks were intended to insure that any increases in these metals due to increased transportation use do not degrade the waters of the South Bay. Actions specific to urban runoff are included in Appendix B of the recently adopted NPDES permit.

District monitoring activities to date: In response to a Metals Control Measures Plan finding that runoff from certain industries may contain significantly elevated concentrations of copper, SCVURPPP (in cooperation with the cities of Sunnyvale and San Jose) monitored runoff from various industrial sites and identified the types of industries deserving of further scrutiny. A follow-up project focused on identifying and controlling specific sources within these sites.

As part of the SCVURPPP's Stormwater Environmental Indicators Demonstration Project (SEIDP), Cooke and Mineart (2000) reviewed the 1990-1996 storm water quality data from Coyote Creek. The authors noted the correlation between sediment (TSS) and nickel concentrations, which supports the conclusion that the nickel load in storm water is primarily from the erosion of soils containing high natural concentrations of nickel. Also for the SEIDP, Buchan (2000) examined industrial runoff data reported to the SWRCB and developed GIS-based tools for mapping these sources within specific storm drain segments and watersheds.

Effects on future District monitoring: As part of the Copper/Nickel Control Actions, SCVWD is tracking copper sulfate use by water suppliers (including the State Water Project and Central Valley Project). SCVURPPP is targeting industrial inspections to sites that may have above-normal concentrations of copper in runoff. The copper and nickel action plans depend on RMP data for evaluation of potential increases in copper in South San Francisco Bay. In addition, the plans include various programmatic measures (e.g. vehicle trips) that could trigger additional actions. These will be followed by SCVURPPP.

III.D.2.b. Mercury in All San Francisco Bay Segments:

Background: Bay waters frequently exceed the concentration criterion for mercury, but inorganic mercury is poorly absorbed into plant and animal tissues. Methylated mercury, produced in a complex cycle in certain natural environments (including wetlands) is more easily absorbed and can bioaccumulate, resulting in relatively high concentrations in the tissues of fish-eating birds and mammals. Of the mercury sources to the Bay, most is in sediments that were washed into the Bay and its tributaries during the gold rush era.

The listing of mercury as an impairment to San Francisco Bay is based on exceedance of the Basin Plan numeric objective for mercury in water (0.025 µg/L), and because of the potential for mercury to bioaccumulate in fish. Analysis of fish caught in San Francisco Bay shows that some species (e.g., leopard sharks) exceed the Food and Drugs Administration (FDA) limit for mercury in fish (1 µg/g). In December 2000, USEPA published criteria validating the reference dose of 0.3-µg/g methylmercury and recommending that states adopt site-specific standards based on local consumption. The RMP recently completed a survey of fish consumption by anglers in San Francisco Bay and a third study of concentrations in fish tissue.

Regional Board staff worked with a stakeholder group, called the Mercury Council, to develop a TMDL report. The August 2001 report sets targets for inorganic mercury in sediments based on percent fines (<63 µm) in the sample. Sediments from the Sacramento River are used as reference; the Sacramento River contributes 80% of sediments reaching the Bay. The methylmercury target is 0.5-mg/l in water, based on the FDA limit for fish, a bioaccumulation factor of 10 and a safety factor of 2. Most of the Bay is below this limit, but the highest concentrations are near the Guadalupe River.

The most recent draft of the San Francisco Bay Regional Water Quality Control Board staff report entitled "Water Quality Attainment Strategy for Mercury in San Francisco Bay," was made available to the Mercury Council in November 2001. The draft report identified and quantified the following potential sources of mercury to the San Francisco Bay:

- Central Valley watershed sources, approximately 58 to 74%
- Sediment remobilization, approximately 17 to 30%
- Urban stormwater runoff, approximately 4%

- Guadalupe River, approximately 1 to 4%
- Local watershed background load, approximately 1 to 3%
- Wastewater discharges, approximately 1 to 2%
- Direct (on-bay) atmospheric deposition, approximately 1%

Potential sources of mercury to stormwater runoff in Santa Clara County include indirect atmospheric deposition and improper disposal of mercury-containing products. The most likely controllable source of mercury in urban runoff is eliminating or reducing the improper use and disposal of mercury-containing products.

District monitoring activities to date: District staff participated in the Mercury Council. In March 2000, Bay area stormwater agencies, including SCVURPPP, received an RWQCB request to assist with research into the concentrations of PCBs and mercury in stormwater. SCVURPPP developed a plan to characterize concentrations in storm drain sediments throughout the Bay area. SCVURPPP, with the participation of five other stormwater agencies, conducted this monitoring in the fall of 2000 and issued a report in February 2001.

Effects on future District monitoring: The RMP has completed a study of air deposition rates for mercury, and the RMP's 2002 monitoring plan includes ongoing sampling through 2004 to contribute to a national database of airborne mercury sources from large urban areas.

SCVURPPP's March 1, 2002 workplan submittal to the RWQCB includes a required Mercury Pollution Prevention Plan. Pollution prevention activities focus on proper disposal and recycling of consumer goods, such as fluorescent bulbs and thermometers, that contain mercury. The submittal also recommits SCVURPPP to ongoing support for various regional monitoring activities, including:

- Support for the RMP Atmospheric Deposition Pilot Study.
- Mercury-related activities in the Clean Estuaries Plan MOU.
- Completion of the second year of the Joint Stormwater Agency Project to Study Urban Sources of Mercury and PCBs.
- Including mercury studies in a 5-year SCVURPPP monitoring plan.

A substantial portion of total loading to San Francisco Bay, and particularly the South Bay, is from the Guadalupe Watershed. A separate TMDL, described below, is being prepared for that watershed.

III.D.2.c. Mercury in the Guadalupe Watershed

Background: From the Gold Rush era until 1975, cinnabar was mined from the New Almaden Mining District on the eastern side of this watershed. Mine tailings were deposited in drainages, or eroded into the drainages. Inorganic forms of mercury washed downstream to wetland areas where, in biologically active environments, inorganic mercury can be transformed into methylmercury. This form of mercury can be absorbed into plant and animal tissues and bioaccumulates in the food web.

In 1987 and 1988, using grant funding from the state's Bay Protection and Toxic Cleanup Program, the CDFG collected fish tissue data in Almaden, Guadalupe, and Calero reservoirs and several locations in Los Alamitos Creek and Guadalupe Creek. Concentrations exceeded the Federal Food and Drug Administration's action level of 1 ppm for fish. The data was used to support fish consumption advisories issued by the California Office of Environmental Health Hazard Assessment.

These concentrations of mercury could adversely affect the people consuming the fish. Mercury concentrations in sediment exceed values that may increase mortality and teratogenesis in rainbow trout embryos. The concentrations of mercury in fish may be harmful to fish-eating birds, such as the common merganser, black-crowned night heron and belted kingfisher. USFWS recently completed a Natural Resource Damage Assessment to estimate the lost value of natural resources in the Guadalupe watershed.

However, these conclusions are largely based on old data. Since 1988, the County of Santa Clara and the District have removed or immobilized much of the mercury-laden sediments in the watershed. In 2000, the state Department of Toxic Substances Control announced that remedial actions had been completed and that the New Almaden Mining District (now Almaden Quicksilver County Park) was no longer a threat to public health or the environment. The District has removed large quantities of mercury-laden sediment through routine and one-time dredging, and has stabilized stream banks in Guadalupe Creek. The resulting reduction in mercury loading has not been estimated, nor has any monitoring been done to evaluate residual mercury loading.

District monitoring activities to date: the District has sampled sediments in connection with the construction and maintenance of flood protection facilities. Sediment sampling is routinely conducted to avoid construction delays and to characterize the sediments for evaluation of disposal options. Sampling has been sufficient to generally characterize mercury concentrations in creeks upstream of reservoirs, in Guadalupe Creek and the Guadalupe River, and in sloughs downstream of Highway 237.

Effects on Future District Monitoring: The District is the lead agency for SCBWMI participation in the TMDL for the Guadalupe watershed. The SCBWMI's Guadalupe River Mercury TMDL Workgroup developed a Recommended Interim Sampling and Monitoring Plan. The Plan identifies the following objectives for filling data gaps:

1. Define baseline or pre-mining concentrations of mercury in sediment in the South Bay, Guadalupe River and reservoirs.
2. Investigate sediment sources, transport and accumulation areas (fluvial geomorphology). These tasks may include modeling and measuring total suspended solids (TSS) throughout the watershed.
3. Identify runoff sources of mercury to the waterbodies. Runoff sources include urban runoff and potential erosion areas. Potential erosion areas should also be investigated for the amount of mercury in the soil. There are some known locations in the historic mining areas and along the riverbanks that have large deposits of calcinated wastes from the mining activities. Mapping the locations of high mercury concentration sediment along the riverbanks would assist in identifying potential erosion areas.
4. Collect data on air deposition and sources of mercury in the air. An investigation of air deposition rates should also evaluate evasion rates.
5. Sample fish and other biota for mercury concentrations.
6. Study bioaccumulation of mercury by investigating methylation/demethylation, ecosystem structure in the Guadalupe watershed and the bioavailability of mercury sources identified in the watershed.

The District selected a consultant team and negotiated a fee (current estimate is approximately $900,000). The project is suspended pending funding.

In addition to monitoring needed to support the TMDL, additional investigations may be needed to evaluate the effect of mercury on natural resources. These investigations might focus on the transport of mercury in upstream water and sediment to reaches downstream of the reservoirs, the production of methylmercury (in reservoirs and stream reaches), and the relationship of mercury in water and sediments to its occurrence in fish tissue and in piscivorious birds.

III.D.2.d. PCBs in San Francisco Bay

Background: PCBs are a group of over 200 organic chemicals. Manufactured from 1929 to 1979, PCBs were used as hydraulic fluids, lubricants, plasticizers, insulators in electrical transformers, in industrial paints and coatings, and in carbonless copy paper.

PCBs bioaccumulate; fish and fish-eating birds and mammals (including humans) are most vulnerable. PCBs vary in toxicity; long-term exposures have been associated with developmental abnormalities, disruption of the endocrine system, impairment of immune function, and cancer.

The U.S. banned sale and production of PCBs in 1979.

The replacement of joint caulking at Alameda County's Dunsmuir Reservoir in 1992 resulted in a substantial accidental discharge of PCBs to San Leandro Creek.

A 1994 RWQCB Fish Contamination Study (SFRWQCB, et., at., 1995; Fairy, et., al., 1997) found that PCB concentrations in fish throughout the Bay exceeded screening values; this led to health advisories for the consumption of sport fish.

San Francisco Bay waters exceed the California Toxics Rule criterion (170 μg/L total PCBs) at all locations; exceedances of this low limit may also be found in samples from Arctic waters.

District monitoring activities to date: RMP data from 1994 first showed that Bay waters exceed the EPA criterion for PCBs. In addition to its ongoing direct financial support for the RMP, in 1988 SCVURPPP provided additional funding to support an Estuary Interface Pilot Study. That study included sampling near Standish Dam on Coyote Creek and in Alviso Slough. The authors concluded that South Bay watersheds might be ongoing sources of PCBs (as well as chlordane, dieldrin and other pollutants) to San Francisco Bay.

District support for the RMP (through SCVURPPP) helped support SFEI staff participation in two workgroups: a Sources, Pathways, and Loadings Work Group (SPLWG), and a Chlorinated Hydrocarbon Work Group (CHCWG). The workgroups concluded that there was no declining trend in PCB concentrations in water, sediment or mussel tissues since the early 1980s.

After creating a mass budget for PCBs and estimating losses due to outflow, burial, and volatilization, the workgroups concluded that the persistence of PCBs in the Bay is due to continuing inputs from the surrounding watersheds. Air deposition may also be a significant source.

Through SCVURPPP and BASMAA, the District supported the design and implementation of a multi-stormwater-agency study to characterize the concentration of PCBs and mercury in storm drain sediments. Follow-up studies include characterization of sediment concentrations at tributary mouths and tracking down of "hot spots."

In 2000, the District allowed access for a City of San Jose/Silicon Valley Toxics Coalition project to measure the accumulation of PCBs in transplanted clams in the Guadalupe River, Coyote Creek, and Sunnyvale East Channel.

Effects on future District monitoring: Because it is a top-priority for the Regional Board, the PCB TMDL is well underway. Implementation requirements may include intensified searches for and remediation of "hot spots," although broader requirements to control urban storm drain sediments are also possible. Cities' urban runoff pollution prevention programs would be the first to be called on to implement these controls. SCVURPPP is preparing a 3-year plan to further characterize PCBs in the watershed, identify areas with elevated PCBs, and identify control measures.

III.D.2.e. Chlordanes, DDTs, and Dieldrin in San Francisco Bay

Background: The previously cited Fish Contamination Study and follow-up work by the RMP published in 1999 (SFEI. 1999) showed that a significant percentage of samples contained concentrations of DDTs, chlordanes, and dieldrin that were above screening values for some species. In general, higher concentrations were found in more industrial areas, particularly in the Oakland Inner Harbor.

Although these chlorinated hydrocarbons (CHCs) were used for agricultural and household pest control, rather than industrial applications, all three share many key characteristics with PCBs: they are no longer produced or used, but persist in sediments and are biomagnified in the food chain.

District monitoring activities to date: A literature review by the RMP Chlorinated Hydrocarbon Work Group (CHCWG) noted that 1997 fish tissue DDT concentrations are as little as 3-5% of the values in 1965, when DDT was partially banned. However, most of the decrease occurred soon after the halt in widespread use. The CHCWG concluded that future decreases in the concentrations of CHCs would be slow, due to re-suspension of sediments and continuing input of polluted sediments from contributing watersheds. High concentrations CHCs in the North Bay following the January 1997 flood suggest significant transport of polluted sediment particles from the Central Valley.

Effect on future District monitoring: The RMP CHCWG noted the need for long-term monitoring of CHCs. Targeted monitoring of animal tissue is cost-effective because it more closely tracks potential effects, integrates exposure over time, and is easier to sample. Monitoring of fish tissue will continue to be necessary because of its link to human health effects and the regulatory basis for 303(d) listing. Bivalves and of the eggs of piscivorous birds are easier to collect and more likely to provide evidence of long-term trends. These studies will be continued by the RMP (with District support through SCVURPPP).

USEPA has listed these pollutants; the RWQCB has not yet scheduled development of a TMDL. However, anticipating the need for data similar to that required for PCBs, SCVURPPP and other stormwater programs are collecting data on the distribution of CHCs in storm drains. This has been incorporated into the second year of the stormwater programs' PCB/mercury sampling effort.

III.D.2.f. Diazinon in urban creeks

Background: Diazinon is an organophosphate pesticide that is widely marketed for home and garden use. It is also used in commercial agriculture. Unlike organochlorine pesticides such as DDT, it is not bioaccumulative and usually persists for only 7-40 days in surface waters.

As early as 1992, studies by the Santa Clara Valley Nonpoint Source Pollution Control Program (predecessor to SCVURPPP) suggested that some toxicity in runoff might be due to organic compounds. Subsequent toxicity identification evaluation (TIE) procedures associated observed toxicity with diazinon (Katzenelson and Mumley 1997). Grab samples from creeks throughout the Bay area in 1995 showed widely ranging concentrations of diazinon, with many in the range associated with laboratory toxicity to *Ceriodaphnia dubia*.

The RWQCB chose to list all urban creeks (36 are named) as impaired by diazinon. Currently, there is no water quality objective for diazinon, and the impairment findings are based on assessment of only a few urban creeks that are considered representative of all urban creeks in the region.

USEPA has reached a voluntary agreement with diazinon's chief manufacturer, Syngenta, to phase out all home and garden applications of the pesticide over the next four years. The phase-out responds to concern over potential health impacts of exposure, particularly to children.

District monitoring activities to date: In addition to participation in the 1992 and 1995 studies noted above, the District has been involved (through SCVURPPP) in the activities of the Urban Pesticide Committee, which has sought to develop an effective approach to limiting the use of diazinon. SCVURPPP activities have included promotion of integrated pest management and of other alternatives to pesticide use.

Effect on future monitoring: Despite the national phase-out of diazinon, Regional Board staff declined to recommend the de-listing of diazinon in urban creeks, citing the need for in-stream data indicating that concentrations are below those associated with aquatic toxicity.

With the planned phase-out of diazinon and the trend to reducing use of organochlorine pesticides, regulatory attention has turned to possible successors, including pyrethrins and pyrethroids, and whether these naturally derived bug killers, or other "third generation" pesticides might be associated with toxicity in urban creeks.

III.D.2.g. Diazinon in San Francisco Bay

Background: During the winter, dormant spray insecticides, such as diazinon, methidathion, and chlorpyrifos, are applied to orchards and then transported by rainfall into the Sacramento and San Joaquin Rivers. USEPA has listed the entire San Francisco Bay as impaired by diazinon.

District Monitoring Activities to Date: An RMP study of episodic toxicity in the Sacramento-San Joaquin Delta (Ogle and Gunther 2000) included sampling in Guadalupe Slough and at two North Bay sites. Results found both toxicity and elevated concentrations of diazinon and chlorpyrifos in some samples; however, there was no reliable correlation between the presence of the pesticides and the observed toxicity.

Effect on future monitoring: Toxicity in Bay water and sediments will continue to be a concern. The RMP has issued a request for proposals for studies that to follow-up the episodic toxicity study. A variety of approaches will be considered.

III.D.2.h. Selenium in San Francisco Bay

Background: The primary sources of selenium to San Francisco Bay are wastewater from petroleum refineries (located in the north Bay and Carquinez Strait) and drainage from San Joaquin Valley soils that are naturally rich in selenium.

Selenium discharges from refineries have been substantially reduced through new treatment technology. As a result, selenium concentrations in the North Bay have decreased by approximately two-thirds since the early 1980s.

Reducing selenium in agricultural drainage is proving more difficult. Drainage from San Joaquin soils to the Kesterson Reservoir sink resulted in an accumulation of selenium sufficient to cause birth defects in birds that nest there. Rerouting of the San Luis Drain to the San Francisco Bay/Delta is still under consideration.

The RWQCB has scheduled a selenium TMDL for completion in 2010.

District monitoring activities to date: RMP data has shown that concentrations of selenium, like that of most metals, are higher in the South Bay than in other Bay segments. This is most likely due to drainage from upstream agricultural and open-space areas, and the tendency of pollutants to concentrate in South Bay water and sediment due to evaporation and lack of circulation.

Effect on future District monitoring: The methodology and data collection used for the higher-priority TMDLs (mercury, PCBs) may provide some insight into what data may be called for as the RWQCB begins to implement the selenium TMDL.

III.D.2.i. Dioxins and Furans in San Francisco Bay

Background: In 1999, USEPA added dioxins and furans to the 303(d) list of pollutants impairing San Francisco Bay. Dioxins, furans and "dioxin-like" PCBs are on the RWQCB's TMDL schedule, but dates for start and completion are "to be decided."

Like PCBs, dioxins can be extremely toxic in low concentrations and tend to adhere to sediments. Unlike PCBs, they have a plethora of continuing sources, including nearly all types of combustion – particularly the combustion of wood in stoves and fireplaces.

Effect on future District monitoring: Provision C9e of the District's stormwater NPDES permit requires characterization of the distribution of PCBs and PCB dioxin-like compounds in urban areas of the Santa Clara Basin. The provision also requires "identification of control measures and/or management practices to reduce or eliminate discharges of PCBs or dioxin-like compounds from urban conveyance systems."

SCVURPPP's March 1, 2002 workplan for dioxins calls for:

- Reviewing readily available data on methods used to characterize dioxin-like compounds in stormwater runoff and surface waters and concentrations typically found.

- Reviewing readily available data on dioxins concentrations in Bay area stormwater runoff. A February 1998 Regional Board staff summary report indicates that data from a Regional Board study showed similar concentrations and characteristics of dioxins in stormwater runoff throughout the region, independent of industrial activity.

- Reviewing readily available data on dioxins concentrations in Bay area surface waters. If available, SCVURPPP will review the results of a recent dioxins sediment survey by the USEPA. The survey included collection of samples throughout the Bay, at river mouths and in some marshes.

- Comparing stormwater runoff concentrations to ambient surface water concentrations, with emphasis on available data for the Bay area.

SCVURPPP will prepare a technical memo on the information review by October 1, 2002. If field sampling is recommended, the memo will provide general information on recommended sampling and analytical methodologies and a schedule for implementation in the Santa Clara Basin.

III.D.2.j. Sediment and Siltation in San Francisquito Creek

Background: San Francisquito (SF) Creek possesses one of the few remaining steelhead trout populations in the San Francisco Bay area. Adult steelhead enter the mouth of SF Creek, migrating upstream to spawning habitat located on Los Trancos Creek and Bear Gulch Creek tributaries. In the early 1990s, a group of local citizens began working on plans to clean up and enhance San Francisquito Creek. The Peninsula Community Conservation Foundation adopted a formal Coordinated Resource Management and Planning (CRMP) process in 1993. A watershed plan was prepared in 1995 and 1996.

A February 1998 flood brought new urgency to flood management issues. That same year, the RWQCB added San Francisquito Creek (along with San Gregorio Creek and Pescadero Creek in San Mateo County) to the 303(d) list, stating that they were impaired by sediment and siltation.

Meanwhile, the CRMP (now the San Francisquito Creek Watershed Council) has produced its own Long Term Monitoring and Assessment Plan (LTMAP) for the San Francisquito Creek watershed. The LTMAP includes metadata for existing studies and outlines future monitoring needs. The LTMAP notes the extensive number of previous studies of San Francisquito Creek watershed hydrology and geomorphology, including problems of sedimentation.

As the RWQCB's TMDL workplan for these creeks acknowledges, "specific expression and spatial extent of stream-riparian habitat impairment is poorly documented" and that "a broader, more holistic, analytical framework is needed when the principle objective of a TMDL is salmonids recovery."

However, the stormwater NPDES permit requires SCVURPPP to provide: "(1) quantitative characterization of sediment and water inputs to the creek; (2) relative roles of sediment associated with natural and anthropogenic land use discharges; (3) sediment conveyance from headwaters to the Bay, and (4) development of a rapid sediment budget."

District Monitoring Activities to Date: In the NPDES permit issued to agencies participating in the San Mateo Countywide Stormwater Pollution Prevention Program (SMSTOPPP), the

RWQCB required an "erosion control and prevention plan" and required SMSTOPPP to participate in development of the SCBWMI's "watershed assessment and management plan."

SMSTOPPP and SCVURPPP worked to obtain state grant funding under Proposition 13; Regional Board staff subsequently issued inconsistent statements regarding whether or not implementation of the grant would meet permit requirements.

To meet specific NPDES permit requirements, the SM-STOPPP co-permittees (San Mateo County, East Palo Alto, Menlo Park, Woodside, Portola Valley) submitted an Erosion Control and Prevention Plan in September 2001. SCVURPPP submitted an assessment of sediment management practices in March 2002.

Effect on future District monitoring: SCVURPPP, SMSTOPPP and other stakeholders are planning a sediment assessment to meet the different requirements of the Regional Board's TMDL workplan, SCVURPPP's NPDES permit, STOPPP's NPDES permit, additional requirements of Regional Board staff, and conditions of grant funding. The proposed sediment assessment is a comprehensive study of sedimentation issues impacting the watershed that will utilize sediment analyses currently being pursued in the watershed by the U.S. Geological Survey and Stanford University. The study includes problem identification, defining goals and objectives, and the coordination of ongoing efforts within the watershed. The draft scope suggests broad geomorphic studies, assessments of habitat, endangered species, and land use, and application of different, possibly overlapping, approaches to assessing sources and impacts of sediment to the creek.

The District participates in this process directly, through SOILS (Sediment Observations in Lotic Systems, a work group of the SCBWMI), through SCVURPPP, through the SCBWMI, and through the San Francisquito Creek Joint Powers Authority (JPA). The JPA is comprised of the District, City of Menlo Park, City of Palo Alto, City of East Palo Alto, and the San Mateo County Flood Control District. The JPA was formed in May 1999 to make decisions that pertain to flood control management of the creek.

III.D.3. Potential new TMDLs:

The RWQCB's November 14, 2001 303(d) Staff Report creates a "watch list" of pollutants and water bodies for which the Regional Board believes there is insufficient evidence for a 303(d) listing, but which deserve further investigation and re-evaluation in the next 2-year listing cycle. The recommendation follows an April 2001 report by the National Research Council. The RWQCB staff report states: "Placement of water bodies and pollutants or stressors on the "watch" list is recommended when anecdotal information suggests they may be impaired but either (1) the available data or information are inadequate to draw a conclusion, or (2) a regulatory program is in place to control the pollutant but data are not available to demonstrate that the program is successful."

The "watch list" is useful to the purposes of the District's current review, as it provides an official "advance notice" of conditions that may appear on the 2004 303(d) list.

The following issues appear on the "watch list" adopted by the Regional Board on November 28, 2001.

III.D.3.a. Sediment or Siltation in other creeks

Background: The RWQCB's November 2001 TMDL staff report acknowledges that: "Sediment impairment assessment (impacts of sedimentation, siltation on beneficial uses) is much more complex than the standard comparison of water column measurements of turbidity or total suspended solids to numeric thresholds…. The conclusions of sediment studies that more sediment is entering streams than pre-European settlement does not warrant a regulatory finding of impairment and sediment TMDL process – there must be an analysis that demonstrates a departure from an expected condition for beneficial use support."

District monitoring to date: On March 1, 2001, SCVURPP submitted a workplan required under the NPDES permit.

Information in the SCBWMI's metadata database (MDDB), supplemented by additional research, was used to evaluate the possibility that specific stream reaches are impaired by sediment. Key sources included the 1999 FAHCE Salmonid Habitat Survey and SCVWD Stream Maintenance Program data.

SCVURPPP staff prioritized stream reaches using a number of key factors and available data. The primary level of prioritization for potential impairment was based on whether the stream reach had a beneficial use designation and the type of fish community present in a study reach. Direct measures of potential sediment impairment included fish habitat survey data characterizing amount of fine sediment in streambed at spawning sites and in pools, as well as benthic macroinvertebrate community structure data. Indirect measures of potential sediment impairment included evidence of bed and bank erosion, sediment accumulation areas, land use, channel modifications, and other information indicating anthropogenic sources of sediment. Factors were weighted for availability and relevance of data.

Based on these ratings and best professional judgment, specific reaches in Stevens Creek and Coyote Creek were identified as highest priority to conduct a watershed analysis and assess existing management practices for sediment and erosion control and prevention.

Effect on future District monitoring: SCVURPPP will submit to the RWQCB a plan and schedule for conducting a watershed analysis and management practice assessment for the high priority stream reaches by September 1, 2002.

III.D.3.b. Trash

Background: The presence of trash in creeks tends to impair passive (non-contact) and active recreational use. Regional Board staff also notes potential impacts on aquatic life uses. Cities around the Bay area commented at length on the Regional Board's consideration of a 303(d) listing and TMDL for all urban creeks for trash. The Regional Board rejected the view that ongoing active municipal clean-up efforts are in themselves sufficient to avoid a listing, as programmatic measures of effort alone do not provide evidence of whether or not the water body is impaired. Regional Board staff recommended placing urban creeks on the "watch list" and requiring assessment and monitoring.

The Los Angeles Basin Regional Water Quality Control Board adopted a Trash TMDL for the Los Angeles River in September 2001. The target quantity is zero, which means that the river and associated water bodies will never be taken off the list of impaired water bodies.

District monitoring to date: The District maintains extensive written and photographic records of specific dumping incidents (enforcement of Ordinance 83-2). However, there has been no systematic patrol of outfalls or drainage ways to evaluate the quantity or extent of trash (or of other evidence of illicit discharge).

Two SCVURPPP projects, currently in progress, address trash. One seeks to identify and map trash "hot spots;" the other expands on an earlier preliminary evaluation of storm drain inlet designs to prevent trash from entering drains.

Effect on future District monitoring: The Regional Board staff report states: "Between now and the next 303(d) listing cycle, municipalities will be expected to assess trash impairments in their jurisdiction, as documented in annual reports to the Regional Board. The approach should mirror the standard TMDL approach of defining the problem, identifying the sources (trash hot spots) through monitoring or existing information, and developing a program of action to address the principle sources, which will likely be associated with schools, convenience stores and restaurants, and places where citizens chronically dump excess garbage in violation of existing litter laws. Regional Board staff will review this specific information in the next listing cycle and determine whether specific water bodies warrant 303(d) listing, and note the existence of relatively clean urban streams."

The specific role of the District in implementing this monitoring will need to be worked out in discussions with other SCVURPPP Co-permittees. The Los Angeles Trash TMDL requires installation of devices to catch trash in storm drains and requires that these be cleaned out within 72 hours after each rain event and every 3 months during dry weather.

III.D.3.c. PBDEs

Background: In 1998, the RMP CHCWG found that "The RMP is underestimating contamination in the Bay by focusing on chemicals that are no longer in use. Uses of most CHCs measured in the RMP were subject to heavy restrictions or bans since 1972 for DDT, 1979 for PCBs, 1987 for dieldrin, and 1988 for chlordane. Continued monitoring of the CHCs is clearly needed. However, the CHCs have been replaced by other pesticides, insulators, and flame-retardants that are required to be highly toxic and/or persistent in order to serve their purpose. Few of the chemicals that are currently in heavy use and are of potential concern in the Bay are currently monitored by the RMP."

District monitoring to date: Subsequent work by Jay Davis at SFEI noted that gas chromatograph (GCMS) traces from cormorant egg samples suggested concentrations of unknown contaminants, later identified as polybrominated diphenyl ethers (PBDEs), a flame retardant. Later studies have found concentrations in the blubber of harbor seals and in human adipose tissue. Although PBDEs are similar in chemical structure to PCBs, and are obviously bioaccumulative, little is known of their effects.

Regional Board staff did not recommend a 303(d) listing for PBDEs because no applicable water quality criteria have been established.

Effect on future District monitoring: Heeding the concerns expressed by the CHCWG and Regional Board staff, it might be efficient and pro-active to analyze for PBDEs (and possible other unknown bioaccumulative organics) when samples are obtained to characterize sources of PCBs and other CHCs.

The RMP 2002 Monitoring Plan includes special studies to sample Bay waters for pollutants on the 1977 USEPA priority list that have not been previously monitored and to review the toxic substances registry for possible substances that may persist in the environment or bioaccumulate.

III.D.3.d. Polyaromatic Hydrocarbons (PAHs)

Background: In the December 14, 2001 303(d) report, Regional Board staff compared PAH data from San Francisco Bay to criteria promulgated by USEPA (California Toxics Rule). Regulated PAHs comprise a dozen individual compounds. Median ambient concentrations were between 0% and 5% of the respective criteria for these substances.

Sources of PAHs include various manufactured hydrocarbons (gasoline, oil, asphalt, tar) and combustion of manufactured or natural fuels (gasoline, wood). They do not tend to accumulate in fish tissue, but do accumulate in shellfish.

The RWQCB placed PAHs on the "watch list" based on the association of PAH in sediment with sediment toxicity and accumulation in bivalves.

Effect on future District monitoring: The RWQCB staff report states: "Over the next listing cycle, the Regional Board expects greater attention from dischargers to sources and control measures for PAHs.... RMP resources will be expected to better assess PAH impacts in the estuary, since the current spatial and temporal coverage does not address areas near the shoreline that may be greater impacted by PAHs in discharges of urban runoff and other sources."

III.D.3.e. Endocrine Disrupting Chemicals

Background: There is evidence that domestic animals and wildlife have suffered adverse consequences from exposure to environmental chemicals that interact with the endocrine system. These problems have been identified primarily in species exposed to relatively high concentrations of organochlorine pesticides, PCBs, dioxins, as well as synthetic and plant-derived estrogens. Whether similar effects are occurring in the general human or wildlife populations from exposures to ambient environmental concentrations is unknown.

Because the endocrine system plays a critical role in normal growth, development, and reproduction, even small disturbances in endocrine function may have profound and lasting effects. Furthermore, the potential for synergistic effects from multiple contaminants exists. The seriousness of the endocrine disruptor hypothesis and the many scientific uncertainties associated with the issue were deemed sufficient to warrant a coordinated federal research effort, underway by the late 1990s.

The RWQCB is creating a separate monitoring program to document bioaccumulative pollutant levels in fish tissue from commonly fished reservoirs throughout the Region. A vitellogenin assay of blood of male fish will be used as a way of detecting estrogen, an indicator of endocrine disruptor chemicals in ambient waters.

District Monitoring to Date: The District participates in the SCBWMI's Endocrine Disrupting Chemicals Workgroup (SCBWMI-EDC), which includes scientists, engineers, regulatory personnel, environmental advocates, water retailers, health practitioners, and community members. The workgroup reviews research and examines EDCs and wastewater treatment technology, water recycling (including streamflow augmentation with recycled water), applications of recycled water (e.g. in cooling towers), and related issues.

Effect on Future District Monitoring: Current focus on EDCs is on wastewater, recycled water, and water supply; however, the most significant environmental effects may be related to PCBs, organochlorine pesticides and other legacy pollutants, as well as commonly used pesticides. For example, in April 2002 researchers at UC-Berkeley published detailed evidence that atrazine, the top-selling agricultural weed-killer, disrupts sexual development of frogs. Rainfall concentrations of atrazine can far exceed threshold levels for biotic effects. Developing knowledge may lead to District monitoring of the occurrence of certain pesticides and other known EDCs in streams and reservoirs.

III.D.3.f. Pathogens

Background: Discerning whether a water body may be impaired because of the presence (or potential presence) of disease-causing microbes is complicated because:

- The relationship between the presence of indicator organisms (typically coliform bacteria) and the presence of pathogens is variable and complex.
- The presence of coliform or fecal coliform may be due to wildlife rather than pollution with human feces.
- Indicator-based water-quality criteria are complex and require calculation of a mean of samples taken within a specified period.
- Actual public health risk depends on opportunities for exposure. Evaluation of actual use for swimming and other contact recreation is required.
- Both use and water quality vary with season.
- Actual public health risk depends on the size and immune status of the population exposed.

District monitoring to date: Citizen monitoring of Saratoga Creek in the early 1990s found some samples with apparently high coliform levels; however, the data were insufficient for comparison with RWQCB Basin Plan objectives. (Further investigation eventually identified sewer leaks draining to the creek.)

To help address this issue, SCVURPPP created a computer-based tool that uses a previously tested model of microbial risk. The screening tool can evaluate coliform data and identify the boundaries of potential health risks based on that data.

Effect on future District monitoring: In January 2001, USEPA published a Protocol for Developing Pathogen TMDLs. The protocol suggests an expanded set of microbial indicators; however, the approach is based on the broad application of criteria, rather than assessment of the actual risk in a specific location.

The RWQCB's 2001 303(d) list adds a number of San Mateo County beaches, and Marina Lagoon in the South Bay, for exceeding Basin Plan objectives for e. coli or for total and fecal coliform.

III.D.4. Surface Water Ambient Monitoring Program (SWAMP) – AB 982 (Ducheny)

Background: In an effort to invigorate the State Water Resources Control Board's (SWRCB's) implementation of TMDLs, the California legislature passed AB 982. The legislation, signed by Governor Davis September 27, 1999, requires the SWRCB to convene advisory panels and submit reports assessing the SWRCB's and the RWQCB's water quality monitoring efforts as those efforts relate to Section 303(d) of the Clean Water Act. The legislation also requires the SWRCB to propose a comprehensive, statewide surface water quality monitoring program.

The San Francisco Bay RWQCB is implementing a region-wide sampling program combining monitoring of fish for contaminant levels in reservoirs and coastal areas where people catch and consume fish and watershed monitoring to assess water quality impacts and establish regional reference sites. The part of the program to measure contaminants in fish will be implemented through the CDFG's Toxic Substances Monitoring Program and Coastal Fish Contamination Program. CDFG will also conduct most of the watershed monitoring (under contract to the Regional Board). Regional Board staff will conduct additional monitoring.

The RWQCB's August 2001 SWAMP Workplan lists Stevens Creek, Permanente Creek and "Palo Alto Creeks" as high priority.

Effect on Future District Monitoring: RWQCB staff has discretion to approve or disapprove submittals under NPDES and other permit provisions and is using that discretion to force permittees to collect and supply data that will help meet the objectives of their SWAMP Workplan.

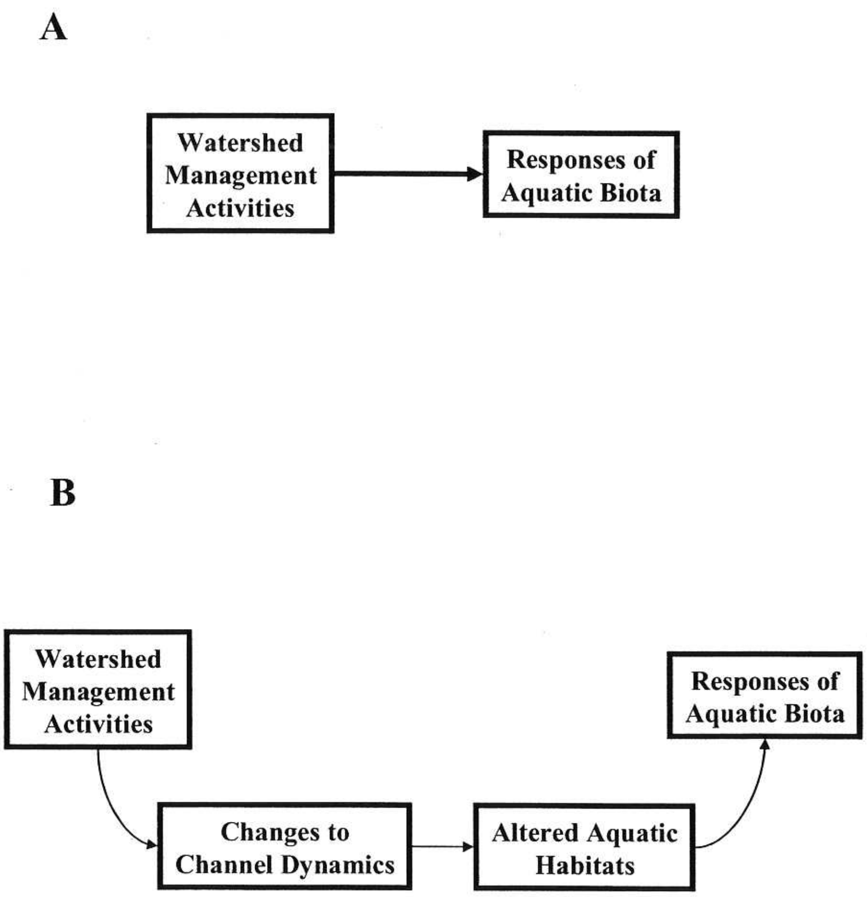
In a December 2001 meeting of the SCBWMI Watershed Assessment Subgroup, RWQCB staff distributed a table listing the type of data they wish to have collected, including timing of collection, methods and methodology, and objectives for interpreting data. The table calls for watershed monitoring, monitoring of sources and loadings for pollutants of concern to San Francisco Bay, and support for the RMP. It states "data will be compatible/integrate with State-wide ambient monitoring program" (i.e., SWAMP).

In the table, watershed monitoring is divided into a "Tier One Screening Level" and a "Tier Two More Focused." Screening level assessments include chemical sampling (including continuous monitoring for temperature, dissolved oxygen, conductivity, and pH), rapid biological assessments and toxicity screening, physical assessments (stream morphology, land use, physical habitat, and riparian vegetation), and flow. More focused assessments call for pollutant chemistry, nutrients, pathogens, and toxicity.

III.D.5. Ecosystem Management and Watershed Analysis

Background. Ecosystem management has been promoted as an approach to land management that is more effective than the traditional project-by-project, species-by-species approach. The goal of ecosystem management is to preserve biodiversity and land ecological capabilities by managing landscapes, habitat components, and communities of organisms in such a way that resources can be utilized on a sustainable basis while protecting ecosystem integrity and biological diversity. Ecosystem management should be driven by explicit goals, and made adaptable by monitoring and research based on our understanding of the ecological processes and interactions necessary to sustain ecosystem composition, structure, and function (Christensen et al. 1996). Although most scientists and members of the public support the concept of ecosystem management, it has generally proved difficult to implement.

Watershed analysis has been developed as a framework for implementing ecosystem management and is being widely implemented throughout the Pacific Northwest (WFPB 1994, FEMAT 1993, Montgomery et al. 1995). At the watershed scale, methodologies have been developed to examine the cause-and-effect relationships linking management actions to direct impacts and their subsequent indirect impacts.


A
Watershed Management Activities
Responses of Aquatic Biota
B
Watershed Management Activities
Responses of Aquatic Biota
Changes to Channel Dynamics
Altered Aquatic Habitats

A primary objective in ecosystem or watershed management is to link the effects of management actions to biological and ecosystem responses (A). To do this, we often use a hydrogeomorphic approach to link management actions to changes in channel dynamics and processes, which alter habitat conditions and lead to specific responses by aquatic organisms.

Figure III - 2: Watershed Analysis Linkages to Management Actions

For example, levee construction disturbance and use of riprap are linked to channel bed and bank stability, which affects sedimentation of streams, influencing stream channel morphology and fish habitat and thereby survival and reproduction within fish populations. In more urbanized watersheds, there have been efforts to link the increase in impermeable surfaces with changes in hydrology, particularly the peaks and timing of storm runoff events.

The development of watershed analysis and its application to management issues has provided a valuable tool for conducting scientific analyses of potential environmental impacts and enabling government agencies, industry, and local landowners and citizens to make informed decisions about how their lands will be managed. The available methodologies, such as the Washington DNR (WFPB 1994) and federal (USDA 1994, RIEC 1995) approaches, continue to develop and improve as users assess their applicability and limitations.

One of the early limitations of these methodologies was their initial focus on timber harvesting, although watershed analysis methods have recently been developed and continue to be refined to address other land uses such as agriculture, ranching, and urbanization within a variety of regulatory settings. During the past 5-10 years, for example, EPA and various other federal agencies have embraced a watershed-based approach for planning and environmental management and restoration in the belief that it offers one of the best means of finding long-term, sustainable solutions to environmental problems (NRC 1999, USEPA 2001). Watershed analysis is currently being improved through the use of GIS and other computer modeling and analysis tools, with a particular focus on the need for better methods of assessing cumulative watershed effects (Ligon et al. 1999, Dunne et al. 2001).

Elements of ecosystem management and watershed analysis approaches are being widely incorporated into various regional or landscape planning processes such as multi-species HCPs and Sustained Yield Timber plans in northern California (Louisiana-Pacific 1997, PALCO 1998) and NCCPs in southern California (http://www.dfg.ca.gov/nccp/), the CALFED ecosystem restoration program in the Central Valley and San Francisco Bay Area (http://www.calfed.ca.gov/), and the North Coast Watershed Assessment Program currently being conducted by the Resources Agency in northern coastal California (http://www.ncwatershed.ca.gov/). EPA and the state Regional Water Quality Control Board are using watershed-based approaches that incorporate environmental risk assessment to develop TMDLs for various streams and rivers in California. TMDLs addressing sediment and temperature in basins where the primary beneficial use of concern is cold water fisheries habitat for salmon and steelhead have recently been developed for the South Fork Eel River, Garcia River, and Redwood Creek in north coastal California (http://www.epa.gov/region09/water/tmdl/), and the San Francisco Bay Regional Water Quality Control Board is currently using a similar approach to develop a sediment TMDL for the Napa River in the North Bay and a mercury TMDL for the South Bay (http://www.swrcb.ca.gov/~rwqcb2/).

Effects on Future District Monitoring: Watershed analysis is also being used as a model for several San Francisco Bay RWQCB programs and policies (e.g. the Stream Protection Policy, the Watershed Management Initiative process, and Regional Monitoring and Assessment Strategy), and the District itself has made steps toward implementing this type of holistic approach through adoption of its stream stewardship policies and support of watershed management within the Santa Clara Basin (e.g. through the Santa Clara Basin Watershed Management Initiative, Santa Clara Valley Urban Runoff Pollution Prevention Program, BASMAA, FAHCE project). These efforts are likely to continue

III.D.6. Collaborative Stakeholder Processes

Background: A collaborative approach involving the use of a facilitated stakeholder process has become the paradigm for resolving many natural resource management problems during the past decade. This approach evolved, in part, from landowner backlash to what was perceived as heavy-handed regulation by federal or state agencies. Many landowners and local governments felt that local stakeholders should have more control over land management decisions or at least more opportunity to head off regulatory actions by undertaking voluntary actions. Recent administrations in Washington, DC and in Sacramento have embraced this approach in hopes that balanced solutions could be found that were palatable to all involved parties. There are many examples of successful stakeholder processes, although their longevity and effectiveness varies.

Some of the key lessons learned from recent experiences in collaborative conservation planning efforts include:

- Involve all affected parties
- Build a broad base of support
- State objectives clearly
- Use a facilitator
- Be open, honest, and straight-forward
- Provide incentives
- Be realistic and equitable in allocating funding responsibilities
- Committed leadership is critical
- Build trust
- Long-term commitment required

Effects on Future District Monitoring: The District has been a major participant in the Santa Clara Basin Watershed Management Initiative, a stakeholder process initiated in 1996 by the USEPA, SWRCB, and Bay Area RWQCB (SFRWQCB 2002). It is described in detail in section III.B.2. The future of this collaborative effort is unclear at this time. The completion of a Watershed Action Plan in late 2002 (supported by the District) will help to determine any future course of action for the group.

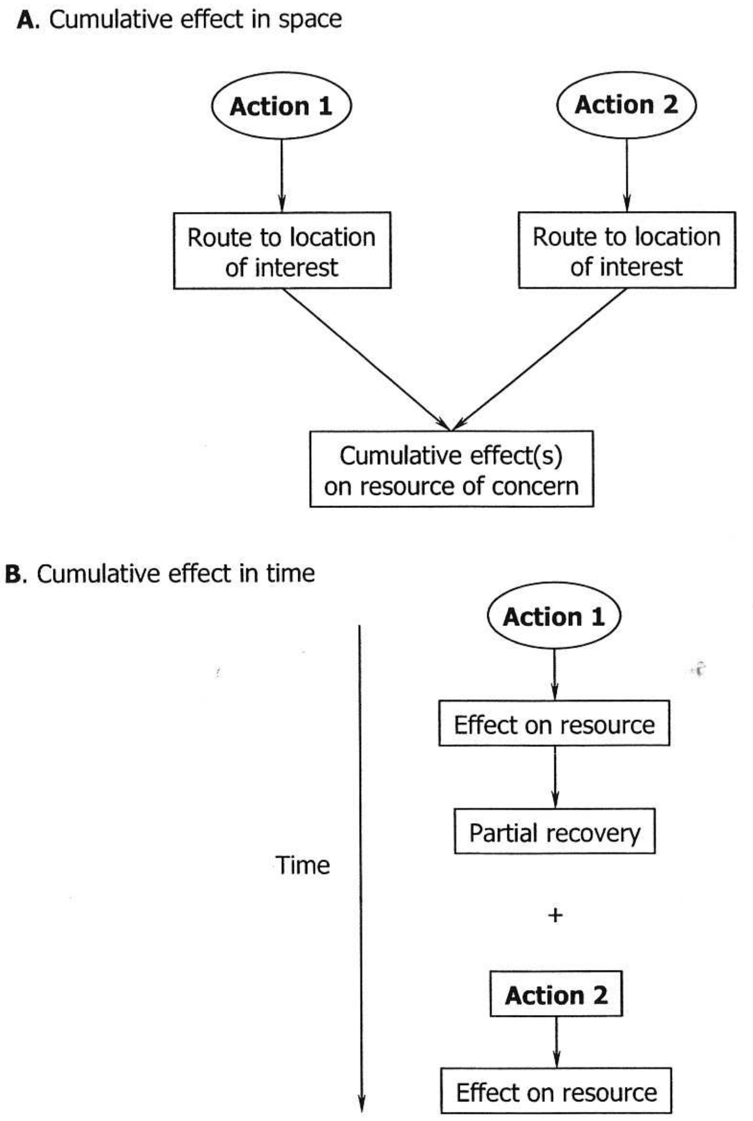
III.D.7. CEQA and Cumulative Impact Assessment

The current trend is for increasing data collection and analysis requirements for CEQA documentation. CEQA requires an assessment of cumulative impacts associated with proposed projects. Until recently, the standards for cumulative impact assessment were nearly non-existent. In recent years, however, environmental groups and some scientists and agencies have openly discussed the inadequacy of current abilities to analyze and effectively avoid or mitigate certain types of cumulative effects. Environmental groups have recognized that inadequate cumulative impacts analysis may provide grounds for lawsuits to stop certain projects. For example, environmentalists have cited inadequate cumulative impact analysis as grounds for a potential lawsuit against Napa County's permit process for hillside development (Kahn 2002, page 1). An integrated monitoring and adaptive management program may be able to help address these needs in a more efficient manner.

The potential importance of cumulative effects in forested watersheds has been recognized for some time (see for example, Coats and Miller 1981). Our understanding of cumulative effects has increased in recent years, but there is still debate about the best methods to identify and predict significant cumulative adverse impacts, the use of regulation to reverse adverse cumulative effects, and approaches to avoiding adverse cumulative effects (Reid 1998).

Cumulative effects result from the combined effect of multiple activities at different locations, sequential activities over time at the same site, or a combination of the two. The idea of cumulative watershed effects may sometimes seem confusing or abstract, but it is based on a simple concept. A single action of limited size, such as a placement of rip rap around an outfall in a relatively unmodified stream channel, is unlikely to have a measurable effect on, say, downstream peak flow or water quality. However, as the proportion of the watershed subject to hardscaping during a given time period increases, the likelihood of detectable changes increases. At some level, the amount of change is sufficient to be both detectable and to have substantial adverse impacts on resources of concern in the watershed.

The concept of cumulative effects implies a persistence of impacts through time, often coupled with a transmittal mechanism through space (MacDonald in press). Figure III-3 illustrates the possible combinations of activities over space or time that can lead to a cumulative effect, while Figure III-2 illustrates the conceptual process for predicting downstream cumulative watershed effects that forms the foundation for the watershed analysis approach (described above in Section III.D.5).


A. Cumulative effect in space
Action 1
Action 2
Route to location of interest
Route to location of interest
Cumulative effect(s) on resource of concern
B. Cumulative effect in time
Time
Action 1
Effect on resource
Partial recovery
+
Action 2
Effect on resource

Possible combinations of management actions over space (A) and time (B) that will lead to a cumulative effect (from MacDonald *in press*).

Figure III - 3: Management Actions Cumulative Effect Analyses

III.D.8. HCPs and NCCPs

Background: Federal and state efforts to protect endangered species have often failed due to problems associated with reviewing individual development and mitigation projects on a case-by-case basis. This incremental approach, while consistent with state and federal Endangered Species Acts, often allowed cumulative impacts, such as habitat fragmentation, to occur even while project developers were encumbered with very expensive mitigation requirements. In other cases, prior to 1982 federal agencies that planned management actions that might have a net positive impact on a listed species but result in some take of individuals were prevented from undertaking such actions because the federal ESA did not allow incidental take permits for this purpose. Concern over these potential shortcomings in the standard approach led to the development of the federal Habitat Conservation Plan (HCP) and Incidental Take Permit process in 1982 (under amendments made in Section 10(a) of the federal ESA) and the Natural Community Conservation Plan (NCCP) process in California in the 1991 (with the enactment of the Natural Community Conservation Planning Act, which is broader in its orientation and objectives than the California and Federal Endangered Species Acts). According to DFG, "The primary purpose of the NCCP program is to conserve natural communities at the ecosystem scale while accommodating compatible land use. The program seeks to anticipate and prevent the controversies and gridlock caused by species listings by focusing on the long-term stability of wildlife and plant communities and including key interests in the process" (htttp://www.dfg.ca.gov/nccp/intro.htm).

The first HCP in the nation was developed in the Bay Area, the San Bruno Mountain HCP in San Mateo County, which was developed to resolve a conflict between protection of two endangered butterfly species and proposed residential development on the mountain. A Steering Committee, which included representatives of local, state, and federal agencies, developers, and local environmentalists, recommended a habitat conservation plan process in 1982. Their recommendations led directly to the amendment of Section 10(a)(1)(B) of the Federal ESA to allow incidental take of endangered species on private property. In recent years, there has been a strong trend for HCPs to include multiple species and larger areas, leading in some cases to regional, multi-species, multi-owner plans. In California these larger and more complex HCPs now tend to be coupled with the state NCCP process. The first examples were focused on coastal sage scrub habitat in Southern California, but similar approaches are now being considered in several other areas, including Alameda, Contra Costs, Solano, Merced and Placer counties (htttp://www.dfg.ca.gov/nccp/intro.html).

Effects on Future District Monitoring: Currently the District is working with the County, and the City of San Jose to develop possible options for the HCP/NCCP planning process. The HCP/NCCP process typically takes 3-5 years to complete and can be quite expensive. The incentives for undertaking this potentially expensive process include regulatory certainty for the parties covered by the permit, allowing participants to proceed with desired development or land and water management activities. The benefits to the District from participating in an HCP/NCCP process include its ability to guide the planning of comprehensive long-term habitat conservation measures in a cost-effective and proactive way. Instead of mitigation on a project-by-project basis, the District could plan watershed-wide mitigation to best benefit the resources of concern and leverage the District's mitigation dollars, (SCVWD 2002).

III.D.9. Ecosystem Health and Hydrogeomorphic Approaches

Background: The decline of salmon and steelhead populations along the western coast of North America has generated much concern. Many parties have pointed to the decline in Pacific salmon, and the subsequent listing of many stocks as threatened or endangered, as an indicator of degraded ecosystem health. A variety of local, state, and federal efforts are currently underway to stop the decline of salmonid populations and begin the process of restoring aquatic ecosystems so they can support recovery of these populations, including efforts to maintain and restore populations of chinook salmon and steelhead in the Santa Clara and Pajaro Basins. The foundation of most of these efforts builds on the concepts of ecosystem management and watershed analysis described above, but they also incorporate related concepts of ecosystem health and hydrogeomorphic assessment.

Successful restoration of anadromous salmon populations is dependent on a variety of factors. One strategy for salmonid restoration consists of maintaining or restoring the integrity of the riverine ecosystem. This strategy requires identification of the key processes and characteristics existing in the natural (or unmanaged) ecosystem, and the development of various methods for restoring some or all of these key elements. In the many California rivers that are managed for water supply, flood control, and hydropower, in addition to being affected by surrounding land uses, the difficulty lies in balancing human uses of the river with maintaining ecosystem form and function. Restoration of the riverine ecosystem has benefits beyond those directly related to salmon, including: maintenance or enhancement of native fish species and other aquatic organisms, amphibians and terrestrial species that utilize riparian habitats; floodplain flood storage capacity; improvement of water quality; and human aesthetic and recreational enjoyment of a river with high quality water and a well-developed riparian corridor (NRC 1992, 1999).

The hydrogeomorphic assessment approach, which is now widely embraced by various agencies and scientists, recognizes the importance of hydrologic and geomorphic processes and conditions in affecting river and riparian ecosystem health, integrity and function (Montgomery and Buffington 1993, Rosgen 1994, Brinson et al. 1995). This approach explicitly recognizes that human land and water management actions, as well as natural processes and disturbances, can alter watershed inputs (e.g., timing and magnitude of water, sediment, or chemical contaminants delivered to the stream channel network) These alterations in turn lead to changes in hydrogeomorphic processes (e.g., timing, duration and magnitude of stream flow, sediment transport, and floodplain inundation), resulting in altered physical habitat conditions and impacts on individuals, populations and communities of aquatic and riparian plants and animals. An example of a conceptual model showing these linkages is shown in Figure III-5 in Section III.D.10.b.

Attributes of healthy riverine ecosystems include intact ecological processes, physical structure (form), and function. Various indicators can be used to assess ecosystem health. For example, in many California rivers, including those in the Santa Clara and Pajaro River Basins, one might use indicators related to physical processes and structure, such as flow regime, channel morphology, and substrate conditions (see McBain and Trush 1997), and biological characteristics such as the relative abundance of native versus non-native fish and other species, macroinvertebrate abundance and community structure, amount of riparian vegetation, and abundance of mature cottonwood and willow trees. The District supported implementation of these types of indicators through the SCVURPPP Stormwater Environmental Indicators Demonstration Project in Coyote Creek, and was directly involved in data gathering for the FAHCE project in the Stevens, Guadalupe, and Coyote watersheds.

Riverine ecosystems are strongly influenced by natural conditions, ecological processes, historical factors, and human land use activities in the associated watershed or catchment. These larger landscape-scale factors affect the five major ecosystem components (energy flow, hydrologic regime, water quality, habitat conditions, and biotic characteristics) that determine riverine ecosystem health. Table III-10 (adapted from Orr 1997) summarizes the relationship of these ecosystem components to indicators of ecosystem health or biotic integrity (*sensu* Karr et al. 1986), potential natural and anthropogenic factors controlling the various components, and provides examples of alterations and ecological impacts caused by human activities in the California rivers (many of the examples are common in many large rivers in Central California). More discussion of ecological indicators is provided in the next section.

Table III - 10: Major Ecosystem Components influencing riverine ecosystem health, biotic integrity, and salmonid ecology. (Modified from Karr et al. 1986 and Naiman et al. 1992.)

Ecosystem Component	Indicators of Ecosystem Health and Biotic Integrity	Potential Controlling Factors	Examples from California Rivers
ENERGY SOURCES	-Type, amount, and size of particulate organic matter entering stream -Sunlight available for instream primary production -Seasonal pattern of available energy	-Latitude -Climate -Topography -Riparian vegetation	Reductions in riparian vegetation have resulted in increased sunlight reaching stream and decreased particulate organic matter (leaves) inputs
HYDROLOGIC REGIME	-Water volume (instream flow) -Timing and duration of floods and low flows -Flood storage capacity	-Basin geomorphology -Climate/precipitation -Human land use -Land cover -Dams and diversions	Dams and diversions have altered magnitude, timing, and duration of flows; changes in land use and cover in watershed have also affected hydrology
WATER QUALITY	-Water temperature -Turbidity -Dissolved oxygen -Nutrients -pH -Chemical pollutants	-Basin geomorphology -Human land use -Natural disturbances -Riparian vegetation	Dams and diversions, land use patterns, and riparian habitat destruction have altered temperature regimes, sediment inputs, and increased nutrients and chemical pollutants
HABITAT CONDITIONS	-Substrate type, subsurface (hyporheic) conditions -Water depth and velocity -Spawning, rearing, and hiding sites -Habitat diversity (pools, riffles, runs, woody debris)	-Basin and local geology and geomorphology -Dams and diversions -Instream gravel extraction -Hydrologic regime -Riparian vegetation	Instream gravel extraction has created new habitat types favoring introduced species; riparian vegetation loss has reduced streambank stability and habitat structure provided by instream woody debris; habitat quality and quantity affected by altered flow regime
BIOTIC INTERACTIONS	-Natural biodiversity -Species diversity and abundance -Trophic interactions -Community structure -Introduced species	-Biotic interactions (predation, competition, disease, parasitism) -Introduced species -Natural and anthropogenic disturbance -Habitat conditions	Introduced predators (e.g., largemouth bass) are a significant mortality factor for outmigrating juveniles; introduced warm water fish species may compete with natives; introduced water hyacinth affects summer low flow habitats

III.D.10. Trends and Developments in Monitoring Methods:

Monitoring is expensive and it is impossible to monitor everything, everywhere, all the time.

Monitoring has often resulted in compilation of massive data sets that are never analyzed, or if analyzed are never linked back to the decision making process. Effective strategic monitoring and management programs use problem identification, clarification of goals and objectives, development of conceptual models, selection of indicators, and assessment of the risks associated with various key uncertainties to decide where time and money should be focused to yield results that have the greatest relevance to critical management decisions. This process of using focused monitoring to address critical management needs and speed up the learning process is commonly referred to as adaptive management. The basic concepts of adaptive management are likely to play a strong role in the District's environmental monitoring and assessment efforts into the foreseeable future.

III.D.10.a. Adaptive Management

Adaptive Environmental Assessment and Management, or Adaptive Management, has gained widespread acceptance since Holling proposed the concept in 1978. Many of the concepts incorporated into adaptive management have been used in other contexts, such as quality assurance and improvement programs in manufacturing businesses, for many years. Various federal and state agencies, along with many private sector resource managers, now use at least some of the key concepts of adaptive management in making decisions and negotiating regulatory requirements. It appears that adaptive management, in one form or another, will be part of the regulatory and management environment of the District during the next 10 to 20 years. For example, adaptive management is explicitly incorporated into the mitigation and monitoring program for the District's Guadalupe River project.

Background
Riverine ecosystems are by nature dynamic and complex, and our understanding of these systems is incomplete. In many instances, managers lack basic baseline information, such as which species are present in the river and their spatial and temporal distributions. More broadly, managers and researchers have incomplete understanding of processes, such as energy and nutrient cycles, which drive riverine ecosystems, how human actions affect these processes, and how the ecosystem could be expected to respond to human intervention. In the face of this uncertainty, multiple state and federal programs are tasked with managing and/or restoring river systems throughout California and the rest of the country.

It is neither feasible nor desirable to postpone action until a complete understanding of each river system can be developed. Developing even a basic understanding can require years or decades, and a complete understanding can likely never be achieved. In light of the lack of knowledge, many programs are attempting to adopt an adaptive management approach to restoration and management. Adaptive management is the process of implementing policy decisions as scientifically driven management experiments that test predictions and assumptions in management plans, and using the resulting information to improve the plans (FEMAT 1993). Adaptive management provides a framework for recognizing uncertainty in management decisions and for reducing uncertainty through experimentation and monitoring. This structured, scientifically driven approach provides an alternative to making decisions without a good understanding of current scientific knowledge or being paralyzed by indecision, both of which have social economic, and ecologic costs.

The Adaptive Management Framework
The Northwest Forest Plan (FEMAT 1993) defines adaptive management as "the process of implementing policy decisions as scientifically driven management experiments that test predictions and assumptions in management plans, and using the resulting information to improve the plans." Adaptive resource management is becoming an integral component of the planning strategy for many resource management agencies and organizations because current scientific understanding of cause-and-effect relationships among management actions, ecological processes, and resource conditions is in many cases incomplete. An adaptive management approach requires a carefully planned structure for monitoring, reviewing management actions, and refining management actions (Holling 1978). The initial focus should be directed largely at designing monitoring studies to test or validate key assumptions, hypotheses, and models used in the development of resource management prescriptions.

The components and pathways of an adaptive management program are shown in Figure III-4. These components include:

- Identification of the problem;
- Establishment of goals and measurable objectives;
- Development of conceptual models that articulate the current set of working hypotheses of cause-and-effect relationships in the system and anticipated responses to management actions;
- Initiation of actions (including targeted research, pilot or demonstration projects, or large-scale restoration actions);
- Monitoring, evaluation, and learning; and
- Feedback leading to revision of the problem statement, goals and objectives, models, and actions as needed.

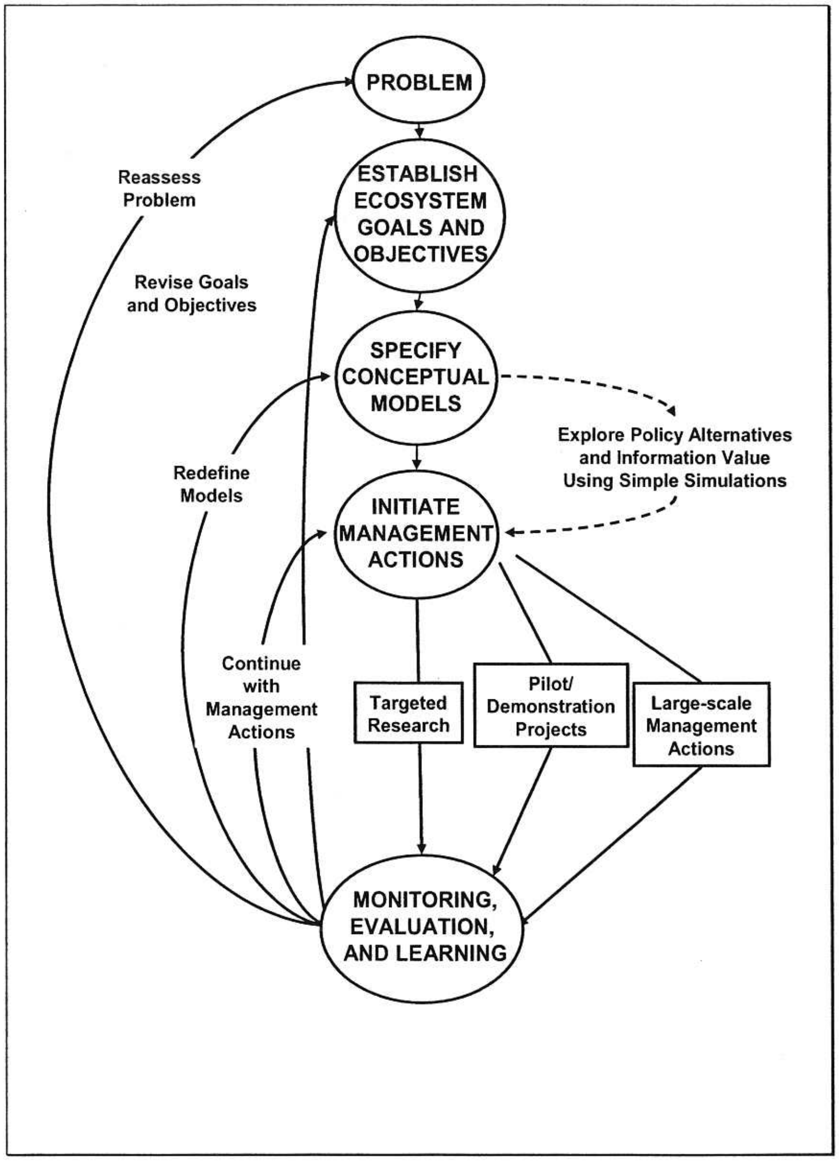

PROBLEM
ESTABLISH ECOSYSTEM GOALS AND OBJECTIVES
SPECIFY CONCEPTUAL MODELS
INITIATE MANAGEMENT ACTIONS
MONITORING, EVALUATION, AND LEARNING
Reassess Problem
Revise Goals and Objectives
Redefine Models
Continue with Management Actions
Explore Policy Alternatives and Information Value Using Simple Simulations
Targeted Research
Pilot/ Demonstration Projects
Large-scale Management Actions

Figure III - 4: Adaptive Management Process

Monitoring is fundamental to the adaptive management approach because it provides the feedback necessary to evaluate the effectiveness of management actions such as BMPs and various mitigation measures, and to identify when these actions should be revised. It also provides information to determine whether the broader, biological goals of the program are being satisfied. In general we separate monitoring into five categories:

Inventory and Baseline Assessments: What are the baseline conditions?
Trend Monitoring: How do conditions change from baseline over time (i.e., trends in conditions)?
Implementation (compliance) monitoring: Are agreed-upon actions being carried out successfully?
Effectiveness monitoring: Are the objectives being met?
Validation monitoring: Are the provisional assumptions correct? How can they be improved?

Inventory and baseline assessments gather physical and biological information that is not designed to test specific hypotheses but rather provides general information upon which more detailed studies may be developed. Data from baseline inventories and assessments may also serve as the foundation for monitoring long-term changes in resource conditions (trend monitoring). Implementation monitoring is used simply to determine whether or not management actions have been implemented successfully. Effectiveness monitoring is used to determine whether successful implementation of one of these management actions or mitigation measures results in achievement of the targeted objective. Validation monitoring is used to test the validity of the conceptual model upon which the action is based and to test the model of the physical-biological linkages (cause-and-effect relations) with which population responses to habitat conditions are predicted. Validation monitoring comprises the research component of the monitoring program.

Some Lessons Learned About Adaptive Management and Monitoring
MacDonald et al. (1991) discuss the conceptual framework for a monitoring program and present many useful ideas. Some of their criteria, which we recommend, are discussed below:

- Hypothesis testing. Monitoring data must be collected to answer a specific question or to verify (or falsify) a specific hypothesis. Implementation monitoring determines whether or not specific actions were actually implemented. Effectiveness monitoring is designed to determine whether specific actions achieve their desired objective; for example, Are waterbars effectively preventing gully erosion on roads? Validation monitoring is designed to test key hypotheses about the effects of land management activities on resource conditions and processes.

- Statistical Validity. This is an important prerequisite for hypothesis testing. Monitoring many project or mitigation sites is problematic from the standpoint of random sampling. Statistically valid sampling is possible, however, provided that the population or universe being sampled (e.g., a specific stream length or reach) is carefully defined. Stratification is often useful. The acceptable statistical power or level of certainty of any statistical test depends on what is being tested and the risks associated with error. For example, the level of certainty that is acceptable in implementation and effectiveness monitoring can typically be somewhat less than that required for validation monitoring. It should be recognized that by minimizing the chance of failing to detect a management effect, we also increase the chance of erroneously concluding an effect exists when, in fact, it does not.

- Reproducibility. The sampling protocol must be set up so that error attributable to differences among technicians is negligible. Two technicians should be able to measure the same parameter and get substantially the same results. Likewise, a technician must be able to take repeat measurements that can be reasonably compared with earlier data collected by another technician. Continuity of collection methods and data formats is important.

- Flexibility. This criterion seemingly conflicts with the need for continuity. However, it is inevitable that some prescribed measurement methods will turn out to be imperfectly suited for the field conditions encountered. In such a case, the method should be modified as soon as possible, even if some previously collected data must be discarded. It is often beneficial to implement a pilot monitoring program first, in order to test the utility of the proposed methodology.

- Simplicity. If possible, the techniques selected should not rely on highly complex and sensitive equipment, nor require extensive training.

- Efficiency. Monitoring requires investments of time and money; therefore it must be focused on the testing of key hypotheses and objectives. Priorities for monitoring should be determined, at least in part, using a risk assessment approach to identify those management activities or prescriptions with the greatest degree of uncertainty concerning their potential impacts and the highest risk of potential damage (environmental or economic) if our assumptions are in error.

- Feedback for Triggering Changes in Management. One of the primary purposes of monitoring is to determine when corrective action is needed to prevent or repair resource damage. It is necessary to define specific thresholds for the measured variables that will trigger changes in management action or practices. The triggers can be some fixed value (such as Maximum Weekly Average Temperature of a stream), or can be defined in terms of change in some variable.

Reed Noss (2001), an expert in conservation biology who has been involved in many HCPs and other landscape planning efforts, gave the following take home messages at a recent regional conservation planning workshop:

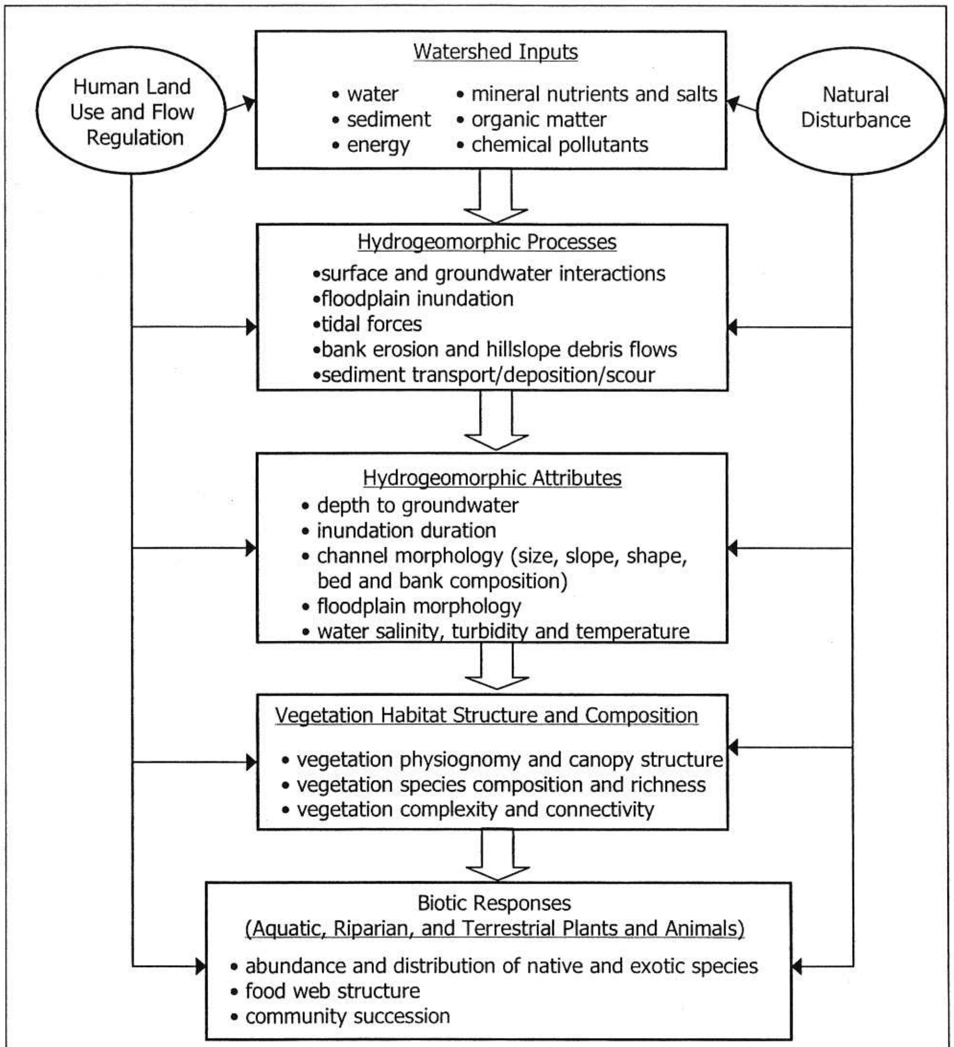
- Ecological monitoring has never been and will never be adequate to answer all or even most of the key questions.
- Hence, it is necessary to identify the most critical management questions which monitoring might help answer, select the most cost-effective and potentially informative indicators, and eliminate blind data-gathering.
- Few adaptive management programs have a valid experimental design. A fully replicated and randomized design is virtually impossible to achieve. Yet, scientific standards of technical rigor and reasonable inference must be enforced.
- An adaptive management program must be explicit about the alternative conservation measures that will be triggered in the event that performance fails to meet stated conservation goals.
- Strive for certainty—scientific and regulatory—but distrust it.

III.D.10.b. Conceptual Models

Conceptual models provide a useful tool for structuring and articulating the current understanding of linkages between ecosystem inputs, physical processes, habitat structures, and biotic responses; identifying information gaps; and developing and articulating hypotheses about the effects of restoration actions on river ecosystems. Most resource managers, scientists, and stakeholders have implicit beliefs or mental models about how the ecosystem functions, how it has been altered or degraded by human activities, and how various actions might improve conditions in the system. The process of developing conceptual models is designed to clarify these implicit models to make explicit the cause-and-effect pathways that are thought to be most critical to the ecosystem and resources of concern (CALFED 2001).

All models are simplifications of reality. They provide a means of reducing some of the complexities of the natural world in hopes of exposing the most critical processes affecting ecosystem function and resource conditions. Conceptual models should be designed with a particular purpose in mind and should contain only those elements thought to be relevant to solving a particular problem. Conceptual models may be presented verbally, graphically, or numerically depending on the context and the current level of understanding. Two simple examples conceptual models are presented below.

Example: General Process-based Conceptual Models
A simplified diagram of a conceptual model underlying a watershed-based approach is shown in Figure III-5 (adapted from Stillwater Sciences 2002). In this model, wetland and riparian vegetation dynamics are tightly coupled with hydrogeomorphic processes. Inputs of water, sediment, nutrients, and other ecological factors provide the raw materials that are shaped by physical forces such as groundwater-surface water interactions, flooding, tidal forces, erosion, sediment deposition, and chemical exchanges to develop wetland, channel and floodplain habitats. These inputs strongly influence plant species composition, distribution, and physical structure (Figure III-5). Vegetation structure and composition, in turn, provide habitat, shade, cover, food, energy, and organic matter inputs for wildlife and aquatic communities and influence their population and food web dynamics.

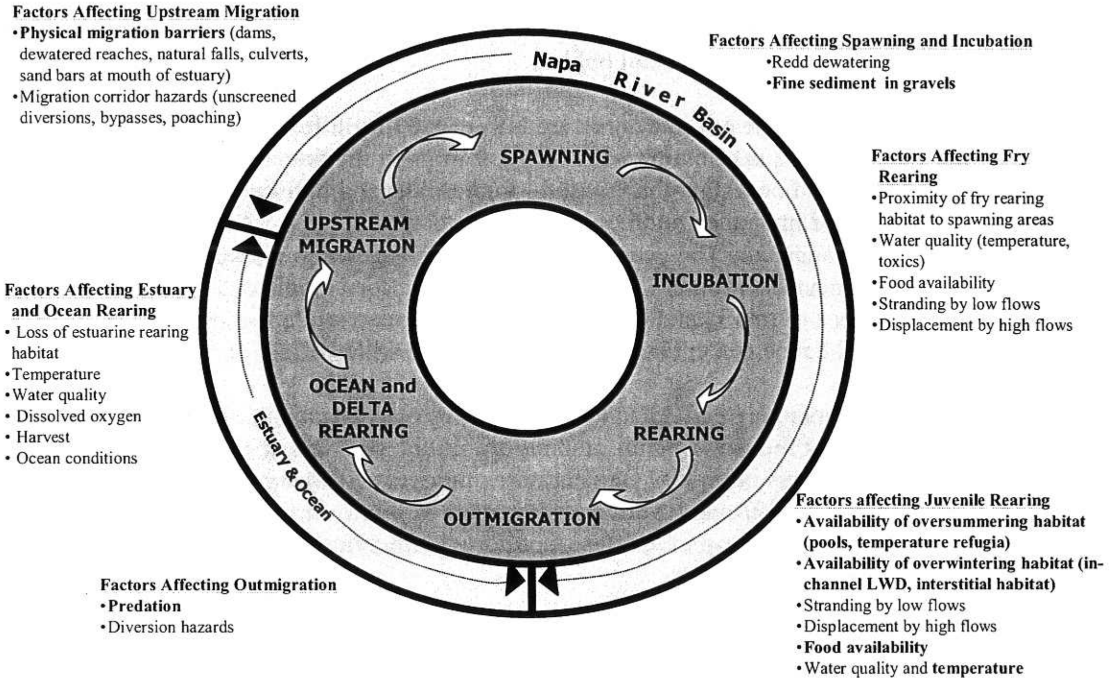

Human Land Use and Flow Regulation
Watershed Inputs
• water
• sediment
• energy
• mineral nutrients and salts
• organic matter
• chemical pollutants
Natural Disturbance
Hydrogeomorphic Processes
•surface and groundwater interactions
•floodplain inundation
•tidal forces
•bank erosion and hillslope debris flows
•sediment transport/deposition/scour
Hydrogeomorphic Attributes
• depth to groundwater
• inundation duration
• channel morphology (size, slope, shape, bed and bank composition)
• floodplain morphology
• water salinity, turbidity and temperature
Vegetation Habitat Structure and Composition
• vegetation physiognomy and canopy structure
• vegetation species composition and richness
• vegetation complexity and connectivity
Biotic Responses
(Aquatic, Riparian, and Terrestrial Plants and Animals)
• abundance and distribution of native and exotic species
• food web structure
• community succession

A simplified conceptual model of the physical and ecological linkages in riparian and estuarine wetland ecosystems demonstrating how an understanding of watershed inputs and hydrogeomorphic processes and attributes can be used predict biological and ecosystem responses to human management actions or natural disturbances (Stillwater 2002a).

Figure III - 5: A simplified conceptual model of physical and ecological linkages in riparian and estuarine ecosystems

Example: General Life-history-based Conceptual Models

Mortality at every life history stage affects population dynamics. It is only by taking a holistic approach that the relative effects of different sources of mortality can be understood. It is within this context that the effects of changes in the watershed will be examined. Aside from mortality factors, we also must understand key factors affecting recruitment, growth, and migration rates if we hope to understand the dynamics of populations of interest. Figure III-6 provides an example of a simple life-history-based conceptual model indicating the factors affecting population dynamics of chinook salmon and steelhead in the Napa River basin. The figure shows the potential limiting factors for each life history stage, with those factors currently thought to be most important indicated in bold type. Similar models have been, or could be, constructed for other San Francisco Bay Area rivers, such as the Guadalupe River or Coyote Creek, to serve as a guide for planning management actions and monitoring efforts.


Factors Affecting Upstream Migration
•Physical migration barriers (dams, dewatered reaches, natural falls, culverts, sand bars at mouth of estuary)
•Migration corridor hazards (unscreened diversions, bypasses, poaching)
Factors Affecting Spawning and Incubation
•Redd dewatering
•Fine sediment in gravels
Napa River Basin
SPAWNING
INCUBATION
REARING
OUTMIGRATION
OCEAN and DELTA REARING
UPSTREAM MIGRATION
Estuary & Ocean
Factors Affecting Fry Rearing
•Proximity of fry rearing habitat to spawning areas
•Water quality (temperature, toxics)
•Food availability
•Stranding by low flows
•Displacement by high flows
Factors Affecting Estuary and Ocean Rearing
• Loss of estuarine rearing habitat
•Temperature
•Water quality
• Dissolved oxygen
• Harvest
• Ocean conditions
Factors affecting Juvenile Rearing
•Availability of oversummering habitat (pools, temperature refugia)
•Availability of overwintering habitat (in-channel LWD, interstitial habitat)
•Stranding by low flows
•Displacement by high flows
•Food availability
•Water quality and temperature
Factors Affecting Outmigration
•Predation
•Diversion hazards

Steelhead life cycle and potential limiting factors in the Napa River basin. Factors thought to be most important in limiting steelhead production in the Napa River Basin are shown in bold (Stillwater 2002b).

Stillwater Sciences

Figure III - 6: Steelhead life cycle and potential limiting factors in Napa River Basin

III.D.10.c. Selection of Environmental Indicators

After the problem, goals and objectives, and conceptual models have been clearly defined, a list of potential parameters or indicators to monitor can be developed. Selection of appropriate indicators will vary with purpose or use, sources of information, the composition of the group selecting the indicators, the intended audience or end user, the timeline, and available budget.

There are various types of indicators. CALFED, for example, has made use of a system that recognizes three primary types of indicators :

- *Status indicators*—which provide easily communicated measures related to species, communities, or habitats valued by the public;
- *Mechanistic indicators*—which represent key hypothetical causal relations that reflect ecosystem operation; and
- *Synthetic indicators*—which integrate multiple indicators into "thumbnail" indices or "scorecards" meaningful to a broad audience.

Monitoring that is directed towards true adaptive management is most likely to involve mechanistic indicators since they are more focused on key ecological processes or states that have relevance to management targets of interest to managers and most applied scientists. Status indicators are more likely to be of interest to the public and various resource and regulatory agencies. Synthetic indicators may be of interest to various experts, integrative scientists and agencies, and the general public.

Different types of indicators are also needed for different types of monitoring. Status indicators, such as the distribution of red-legged frogs in the Santa Clara Basin, or the acreage of wetlands preserved or lost, are most useful for baseline and trend monitoring. Status indicators can also be used for implementation or compliance monitoring (e.g., X miles of channel banks are required to be re-vegetated per year as mitigation for vegetation management operations under the Stream Maintenance Program—the status indicator for compliance monitoring would then be just the number of miles actually re-vegetated each year, while the indicator for effectiveness monitoring might be the percent cover or density of live willows 1, 3, or 5 years after revegetation).

Indicators may be selected to monitor physical, chemical, or biological conditions and processes. Much of the water quality monitoring in the past focused on physical and chemical parameters, such as pH, turbidity, temperature, nutrients, dissolved oxygen, and flow. In recent years, however, EPA and various other agencies have emphasized the value of adding biological parameters to water quality monitoring programs (see Section B below for more details on biological indicators).

III.D.10.d. Risk Analysis

Ecological risk analysis has become an important tool in natural resource management and is being incorporated into programs developed by the EPA (http://www.epa.gov/oppefed1/ecorisk/) and other state and federal regulatory agencies. Oak Ridge National Laboratory has helped develop a number of tools for ecological risk assessment (http://www.esd.ornl.gov/programs/ecorisk/ecorisk.html). Much of the early work in this field focused on ecotoxicology, examining the environmental sources of chemical contaminants, bioaccumulation through the food web, and toxic effects at various endpoints (such as humans or top carnivores in the food web). Initial concepts of zero tolerance for many pollutants led to very expensive control or mitigation efforts, often with little evidence for significant benefits to the environment or affected populations. In many cases, zero tolerance approaches have been replaced by risk assessment approaches in which the probability and magnitude of adverse impact are assessed to come up with an overall risk of impacts, which can then be weighed against potential benefits and costs of proposed actions (including no action) and used to determine what measures, if any, should be taken to avoid or otherwise mitigate the problem.

In the past decade, the concepts of risk assessment have been widely adopted by natural resource managers and regulatory agencies for a broader array of uses than just human health or ecotoxicology. For example, the use of watershed analysis to develop prescriptions for effective watershed ecosystem management typically uses an assessment of both potential hazards (such as the probability of management-induced landslides delivering sediment to the stream channel network) and likely resource sensitivity or vulnerability (such as the likelihood of adverse impacts occurring in spawning gravels or deep pools providing rearing habitat for salmon if sediment loading is increased)

Elements of an ecological risk analysis for riverine ecosystems and watershed management include:

- Identification and characterization of valuable resources in the river and the surrounding watershed, such as threatened, endangered or sensitive (TES) species and sensitive aquatic and terrestrial habitats (including assessment of current conditions and comparison with an undisturbed reference state that is determined using available information on past conditions, key ecological processes and disturbance factors, and best professional judgment about potential conditions in the absence of management-induced disturbances);
- Determination of the vulnerability or sensitivity to disturbance for each of the identified valuable resources (based on existing knowledge of past and current conditions and ecological processes);
- Identification of potential hazards (i.e., sources of natural and human disturbance) that might adversely impact valuable resources;
- Assessment of the risk of significant adverse direct, indirect, and cumulative impacts to these resources of value (based on the distribution of resources on the landscape, the likelihood of disturbance and the sensitivity of these resources to disturbance).

An important objective of the synthesis process is to integrate the results from various watershed assessments, with an emphasis on identifying the relative sensitivity of planning watersheds to direct and cumulative impacts associated with sediment, water temperature, and organic debris so that significant impacts can be avoided, minimized, or otherwise mitigated. Watersheds with higher sensitivity to cumulative effects of watershed land and water management practices may require a higher level of resource protection to prevent or minimize future cumulative impacts. Examples of tools used in this step include the watershed relative risk index and the road erosion relative hazard rating systems (Orr 1997, Olson and Orr 1998).

- Watershed Relative Risk Index (WRRI). The sensitivity of watershed to sediment loading impacts can be evaluated using a WRRI and rating system that combines a measure of the potential for hillslope sediment production with the value and vulnerability of downstream beneficial uses (primarily fisheries, water supply, and water-contact recreation). The WRRI approach allows comparison among watersheds of the estimated potential for adverse cumulative watershed effects related to sediment delivery to stream ecosystems. The WRRI rating system is intended to serve as a screening tool to identify watersheds that might require extra resource protection measures or more intensive monitoring. It can also be used to help assign priorities for watershed mitigation, enhancement, or monitoring studies. At present, the WRRI rating system should be viewed as a hypothesis, based on the best available information, that is useful for regional assessments of the relative risks of degradation of aquatic resources caused by natural accelerated sediment inputs. Testing of the WRRI hypotheses in the specific watersheds can be accomplished with a combination of more intensive watershed analysis and longer-term monitoring.

- Road Erosion Relative Hazard (RERH) Ratings. The WRRI ratings address mass wasting hazards associated with hillslopes and existing roads, but they do not specifically address the hazards associated with delivery of fine sediments to streams from the surface wash off of existing roads. For example, a relative rating system wad developed to help Louisiana-Pacific prioritize its road management activities, particularly road inventory and mitigation for its northern California timberlands (Louisiana-Pacific 1997, Olson and Orr 1998)(. Unlike the WRRI rating system, the road erosion relative hazard (RERH) rating system focuses only n potential hazards (i.e., production of fine sediments and likelihood of delivery of these sediments to the stream network) and not on downstream vulnerable resources (i.e., fisheries habitat and human water uses). The RERH represents a hypothesis about the severity of problems related to fine sediment production caused by existing roads in various watersheds. Like the WRRI approach, the RERH uses a relative ranking to identify those watersheds most expected to have problems. It does not attempt to set absolute standards, or thresholds of concern, to determine if an actual fine sediment problem exists, but instead focuses on setting priorities for road inventory and management efforts.

III.D.10.e. Bioassessment & Biocriteria

What is Biological Assessment?
Biological assessments are evaluations of streams, lakes, and other bodies of water using surveys and other direct measurements of resident biological organisms (EPA 2002, http://www.epa.gov/owow/monitoring/bioassess.html). The measurements typical focus on the distribution and abundance of individual indicator species or on the composition of particular communities or assemblages of species. The results of biological assessment are used to determine if water quality is sufficient to support desired fish, shellfish, and other aquatic species or whether poor water quality is impairing desired beneficial uses (such as a coldwater fishery).

Biological assessment is becoming more widely used throughout the United States. This trend is the result, at least in part, of the failure of traditional chemical or physical water quality monitoring to detect some cases of water quality impairment. The timing of sampling or detection limits of chemical sampling, as well as the need to limit the number of chemical constituents being sampling, can lead to potentially erroneous conclusions that no water quality degradation has occurred when in fact it has. Examples of situations where traditional monitoring missed or underestimated problems in aquatic ecosystems have led many scientists to focus on the use of biological indicators. Biological indicators, such as the presence, condition, and numbers of different types of fish, insects, algae, and plants can provide useful and accurate information about the health of a specific river or lake.

Biocriteria are developed using biological indicators and available data to determine thresholds at which an aquatic ecosystem goes from being a healthy and sustainable system (unimpaired) to an unhealthy and unsustainable or highly altered system (impaired). The notion of biological integrity is useful in this context. Biological integrity is associated with pristine conditions or those with little or no human disturbance. Biological integrity is commonly defined as “the ability to support and maintain a balanced, integrated, and adaptive community of organisms having a species composition, diversity and functional organization comparable to those of natural habitats within a region” (Karr and Dudley 1981). This concept of biological integrity is similar to that of ecosystem health, except the latter explicitly includes both the general idea of biological integrity and the need for ecosystem processes that maintain and support biological integrity.

Biological indicators are now widely used because they have been shown to integrate the effects of various stressors over time and cumulative effects from many separate stressors. In addition, protocols have been developed for sampling biological indicators, particularly fish and insects, that have proven to be cost-effective when compared to alternative (i.e., chemical) sampling approaches in terms of cost, ability to detect impairment, and risk of false conclusions.

The use of biological indicators and biocriteria requires identification of reference conditions. A reference condition may be defined by theoretical threshold or range for a given indicator expected under undisturbed conditions, or it may be associated with conditions at an actual site (or preferably a number of sites) that are known to have experienced little or no disturbance. The reference condition provides the standard or baseline for evaluating monitoring sites and trends through time. Initial ideas of a one-size-fits-all type of reference condition have now given way to a more sophisticated approach that recognized the natural spatial and temporal dynamics of ecosystems. Integration of biological assessment, hydrogeomorphic, and watershed and ecosystem management approaches are leading many scientists to develop reference condition definitions that depend on ecoregion and channel types. For example, the fish or aquatic insects expected in a large, low-gradient sand-bedded river in central coastal California would differ dramatically from those expected to occur in a similar river in Georgia or Florida. Similarly, the fish and invertebrates expected in a small headwater stream tributary to Guadalupe Creek would differ from those expected near the mouth of the Guadalupe River. The use of channel typing systems (e.g., Rosgen 1994 or Montgomery and Buffington 1993) and ecoregions (Omernik and Bailey 1997) greatly facilitates the process of determining appropriate reference conditions for a given stream reach.

In California, the use of bioassessment is strongly supported by various agencies, and has led to the formation of an active bioassessment workgroup to help improve and standardize methods and reference condition data for application of biological assessment to streams and lakes in California.

California Aquatic Bioassessment Workgroup
The State of California has embraced bioassessment as a valuable approach to managing and regulating water quality and aquatic ecosystems. The California Aquatic Bioassessment Workgroup (CABW) was formed in 1994 to coordinate scientific and policy-making efforts towards implementing aquatic bioassessment in California. The mission statement of the CABW, taken from its website (http://www.dfg.ca.gov/cabw/cabwhome.html) is:

> Preservation and restoration of the biological integrity of our nation's waters are goals expressed in the Clean Water Act and shared by California's natural resource agencies. The mission of the California Aquatic Bioassessment Workgroup is to promote the use of biological information in the evaluation of the integrity of aquatic systems.

Members of the CABW consist of biologists from university, consulting firms and industry and representatives of state and federal agencies responsible for assessing, monitoring and protecting the biological integrity of surface waters. Through its Steering Committee and annual meetings, CABW participants develop objectives and strategies for implementing aquatic bioassessment in California.

Specific objectives of the CABW include:

1. Apply consistent, sound methodological approaches to aquatic bioassessment by:
    - Defining and testing sets of procedures for sampling aquatic communities;
    - Establishing reference conditions;
    - Developing quality assurance and quality control procedures;

   - Advancing analytical procedures, such as effective use of appropriate metrics and indices; and coordinating and cooperating with each other and other monitoring partners to reduce duplication of effort and expand bioassessment opportunities.
2. Provide a mentor and support network concerning technical and professional issues for workgroup participants.
3. Facilitate communication by:
   - Enhancing interagency cooperation;
   - Providing an electronics communication platform;
   - Disseminating pertinent technical literature; and
   - Promoting discussion of findings and bioassessment issues.
4. Promote the incorporation of usable quality-controlled data gathered by volunteer monitoring groups into agency bioassessment programs.

III.D.10.f. Emerging Technologies for Monitoring

New technologies are constantly emerging that can be applied to monitoring to reduce costs, improve quality of data available, or even generate new types of data that were not previously available. Some relatively new technologies that are now being used for environmental monitoring and assessment in the Bay Area and elsewhere include:

- High resolution digital orthophotography
- Multi-spectral aerial imagery (including infrared imagery than can be used to quickly monitor surface water temperature),
- Laser altimetry to produce high resolution digital elevation models,
- Global Positioning Systems (GPS) to provide rapid and accurate location information,
- Real-time automated stream flow and weather gauging stations,
- New methods for tagging and tracking individual fish and wildlife,
- Stable isotope methods for detecting water quality impairment and sources, and
- Geographical Information Systems (GIS), which have greatly improved our ability to store and analyze mapped or other georeferenced data.

Many of these recent technologies, such as GIS and GPS, are already affecting the way the District conducts its monitoring activities. As new technologies are tested and become more widely available, the District may find that some of its monitoring requirements can be met more efficiently by switching to new methods rather than following older approaches. Before changing methods, however, the short- and long-term costs and benefits need to be carefully evaluated. In particular, long-term monitoring requires that data be collected using comparable methods. Switching to new approaches may require calibration studies to make sure that new data can still be adequately compared with older data collected with the older methods.

III.E. Current District Monitoring Framework

The purpose of this section is to provide an overview of how and by whom monitoring activities at the District are currently performed. A framework in this review refers to the organizational units, the rules that govern their interaction, the infrastructure that supports these interactions, and the set of activities in which they engage to produce the desired outcome. The outcome referred to here is the completion of a field data collection effort that yields useful information for decision-making purposes.

This report focuses on monitoring activities associated with the CIP and watershed management programs. The following are brief descriptions of monitoring programs within the District that are **not** covered in this report and are outside the scope of this review and evaluation project:

- The Water Quality Unit (WQU) maintains an elaborate, well-established program for monitoring the water quality in reservoirs, raw and treated water transmission and distribution facilities, and water treatment facilities to comply with the Department of Health Services regulations. The WQU uses its own resources and the services of the District's Water Quality Laboratory to carry out its mandated monitoring programs. The WQU generally does not provide monitoring services to other units.

- Groundwater Management Unit (GMU) maintains the District's General Groundwater Quality Monitoring Program consisting of collecting and analyzing groundwater samples from a network of wells distributed throughout the County.

- Operations Planning & Analysis Unit operates and maintains a network of hydrologic measuring stations within Santa Clara County. This network is used for a variety of purposes, including: support of the District's groundwater recharge program, hydrology, flood management, water treatment plant operations, environmental stewardship and emergency operations.

Except for monitoring activities related to the Fisheries and Aquatic Habitat Collaborative Effort (FAHCE), the water quality monitoring programs associated with raw and treated water operations and groundwater management will not be discussed further in this section and are not considered in the conclusions and improvement recommendations of this report.

The monitoring activities that are the focus of this review and evaluation project occur for purposes that fall primarily in the following broad categories:

a) Compliance with project-specific regulatory requirements, and
b) Special studies for assessing the status and/or trends of environmental indicators or resources to support:
  - The Capital Improvement Program during project planning, design, and construction,
  - Watershed Management Operations,
  - Settlement of legal proceedings related to District activities.

Some of these monitoring activities are performed by external parties under contract with the Capital Program Services Division (CPSD), Watershed Program Support Units, project co-sponsors, or external litigants. The remaining monitoring needs are largely provided for by the Ecological Services Unit (ESU) and Countywide Watershed Programs Unit (CWPU) within the Office of Countywide Watershed Management (OCWM) and the Vegetation Management Unit (VMU) in the Technical Services Division.

Presently, ten (10) full-time, regular employees and seven (7) full-time temporary contract employees staffing the ESU perform biological monitoring. Of the regular employees, one is the unit manager, two (2) are wildlife biologists, three (3) are fisheries biologists, one (1) is a water quality specialist, one (1) is a re-vegetation biologist, one (1) is a botanist, and one (1) is a wetland ecologist. The contract employees consist of two (2) wildlife biologists, three (3) fisheries biologists, one (1) water quality specialists, and one (1) botanist.

The VMU staff consists of 17 full-time regular employees, only one (1) of whom (a Vegetation Specialist) performs monitoring tasks associated with mitigation sites and/or initiates and manages maintenance tasks which redress deficient performance identified during monitoring. Two positions in the VMU are currently vacant; neither of which however is for biologists or vegetation specialists.

The framework in which staff from the above two units carry out monitoring activities is described in Table III-11. Units involved and the applicable policies, procedures, standards, protocols, and practices are described for the initiation, planning and design, field implementation, quality assurance, quality control, data management, analysis and modeling, and dissemination of results associated with typical monitoring efforts at the District.

The descriptions in the first column of Table III-11 elaborate on what these activity classes may consist of in environmental monitoring programs in general and, when applicable, at the District in particular. The remaining three columns describe the form in which these activity classes are currently found at the District based on interviews and discussions with District staff in the course of this evaluation.

In Table III-11 we see that many of the elements that are to be expected in robust environmental monitoring programs suitable for complex and extensive monitoring activities and research studies are not found in the existing framework for environmental monitoring at the District. This is not surprising since as shown in section III.A of this report, environmental monitoring activities at the District have so far been relatively simple in nature and limited in scope and size. The majority of these have been compliance monitoring programs, and only a small portion have specifically been undertaken for assessing the status and trends in ecological systems or the effects of management policies and actions on these systems. Consequently, it is to be expected that the monitoring program at the District is not fully developed or adequately designed to meet the complex, larger-scale demands that are anticipated from the planned 15-year capital improvement program, the 10-year stream maintenance program, and from the commitments made to the community with respect to stream stewardship, habitat enhancement and restoration, and improved quality of life in Santa Clara County.

Table III - 11: Current District Framework for Environmental Montoring Activities

Activity Class	Organizational Units Involved	Policies and Procedures	Standards, Protocols, or Practices
Initiation: These are the set of activities that trigger subsequent planning and execution of monitoring events or projects. At the District, this generally consists of one or more of the following: • The approval of a self-monitoring plan by regulatory agencies for a project or an activity. • The end of construction of a project that has a Mitigation and Monitoring Plan (MMP) permit requirement. • Calls to the Ecological Services Unit (ESU) requesting monitoring services as part of settlement processes for legal, regulatory, or stakeholder challenges against District activities. • Emergency responses to unauthorized releases of pollutants to the environment as a result of District operations or activities. • Budgeting for long-term studies and on-going compliance monitoring programs. • Established monitoring cycles and timetables based on seasonal or project requirements.	Any unit needing field observations, surveys, studies, or monitoring of environmental resources or ambient conditions may initiate monitoring activities. For CIP and watershed management programs, involved Units may include: • Business Resources Division o Environmental Health & Safety Unit • Capital Improvement Services Division o Watershed Management Capital Program o Water Utility Capital Program • Watershed Management Division o Watershed Program Support Unit o Watershed Field Operations Unit o Countywide Watershed Programs Unit o Watershed Planning Unit o Regulatory Compliance Unit o Ecological Services Unit • Water Supply Program Division o Operations Planning & Analysis Unit (FAHCE) • Technical Services Division o Construction Management Unit o Vegetation Management Unit Units may request monitoring services from the Ecological Services Unit or they may procure needed services from external parties using normal purchase requests or contracting procedures.	• On the highest organizational level, the District's mission statement upholds environmental sensitivity as a principle that guides the District in pursuing its primary objective of comprehensive water resources management. • Somewhat more explicit but still very general as a guidance to staff, the following Board Ends Policies can be said to apply when environmental monitoring is to be considered: o 3.1. Watersheds, streams, and the natural resources therein are protected and when appropriate enhanced or restored. o 3.1.1. Healthy creek and bay ecosystems are protected, enhanced, or restored as determined appropriate by the Board. • There are currently no established policies or procedures that provide staff with specific directions or guidance on when, how, and from whom to request ecological monitoring services. • The roles and responsibilities in the implementation of a self-monitoring plan or an MMP are usually decided on a project-by-project basis by the Watershed Office that "owns" the project. • There is no policy to guide Staff on what monitoring services may be outsourced directly by the various units and which must be retained through the Ecological Services Unit.	• Current initiation practices are variously modified leftovers from prior District organizational structures. The units involved have adjusted previously recognized roles, responsibilities, and lines of communication for initiating monitoring activities to reflect their own sense of what the most recent watershed centered re-organization implies with respect to monitoring projects. • The roles and responsibilities for the MMP implementation after the Capital Improvement Program Division completes a project and hands it over to the Watershed Division are not clear. There are currently no standards or protocols for handing-over a project that clearly delineates and distributes MMP implementation between the ESU, VMU, WPSU, RCU, and other units that may need to be involved. • There are currently no established standards or protocols for formal budgeting or approval of monitoring services requests apart from or beyond those applicable to all projects and programs during the normal budgeting processes.
Planning and Design: These are the preparatory activities preceding the conduct of the fieldwork. This phase may include one or more of the following: • Review of and coordination with on-going internal or external monitoring activities to maximize efficiency and effectiveness of the planned effort. • Development of: o A project plan and budget. o Applicable conceptual models for use in the interpretation and analysis of the generated data. o Data Quality Objectives (DQO). o Quality Assurance Project Plan (QAPP) o Project-specific quality control procedures. o The study objective and corresponding specifications for sampling period, sites, and sampling regime. • Data management planning.	• Depending on the complexity of the monitoring activity or the project initiating it, this phase may include staff from: o Requesting units as shown above o External and internal stakeholders o Regulatory agencies o Collaborative/regional monitoring programs • Although the staff of the Ecological Services Unit often manages or carries out the monitoring activities, they are generally not engaged in the planning efforts unless and until necessitated by budgeting cycles and processes. • Coordination with other internal or external monitoring activities is rare, and occurs sporadically largely as the result of individual initiative or insight.	• There are currently no established policies or procedures for the organizations and processes that are to be involved. • District staff depends on individual knowledge, experience, and internal relationships to determine when, how, and with whom to plan environmental monitoring. • There are currently no District wide environmental monitoring strategies or policies which are incorporated into the planning of monitoring projects.	• Protocols are highly variable and depend mostly on individual knowledge and experience. • There are currently no standard processes for quality assurance, development of DQO, QAPP, and project design, or coordination with internal or external efforts. • Larger, more high-visibility projects that involve multiple agencies and stakeholders receive more detailed and well-documented project planning and design. This level of planning occurs in response to the concerns of regulators or stakeholders, rather than as a result of the District's own internal standards.

Table III – 11: Current District Framework for Environmental Monitoring Activities (Continued)

Activity Class	Organizational Units Involved	Policies and Procedures	Standards, Protocols, or Practices
Field Implementation: May include some of the following activities: • Measurement of physio-chemical parameters like temperature, pH, turbidity, dissolved oxygen, conductivity, etc., of water or sediments using field instrumentation. • Collection of soil or water samples for laboratory analysis • Collection of specimen for laboratory classification and analysis. • Trapping and field assessment of fish. • Field observation and assessment of riparian vegetation or shaded riverine aquatic habitat. • Field assessment of fish spawning, passage, and rearing habitat. • Wildlife obsearvations. • Channel functions and geomorphology.	• The primary Unit that is ordinarily involved in the conduct or management of field monitoring activities is the Ecological Services Unit (ESU). The ESU relies on internal resources in the form of regular and contract employees, field equipment and instrumentation, as well as on contracted services through open purchase orders or specific agreements with external consulting firms. • Staff of the Vegetation Management Unit (VMU) also participates in field monitoring activities, but these are usually limited to vegetation and mitigation sites. • The Land Surveying and Mapping Unit usually provides surveying services for sample locations at the request of the units conducting the fieldwork. • The Countywide Watershed Programs Unit maintains an open contract with an outside firm for providing field sampling and monitoring services on an as needed basis. However, this contract is used mainly for sampling of water and sediment associated with property acquisition investigations and annual stream maintenance projects.	• None were found relating to field sampling or monitoring activities by District Staff. Due to the relatively small size of the ESU, field assignment details are communicated to field staff by variable means depending on the project manager, and no formal written procedures were found in this review for work assignment, equipment check-out, mobilizations, demobilization, equipment clean up and return, processing and storage of samples, etc. • Contracts with outside sampling firms usually include specific procedures for requesting field-sampling services with corresponding review and authorization steps within the organizational units that administer the contracts.	• Outside contractors or consulting firms that provide field sampling and monitoring services conduct these activities in accordance with the established standards and protocols of the particular disciplines and/or regulatory frameworks to which the monitoring activities belong (e.g., chain-of-custody protocols and sample collection, preservation, storage, and holding time standards of the California Environmental Protection Agency). • Field sampling and monitoring techniques for biological indicators vary between projects, and for vegetation monitoring, between ESU and VMU. However, used techniques usually conform to generally accepted practices and/or to protocols promulgated by the resources agencies that require or oversee the monitoring activities (e.g., California Department of Fish and Game, National Marines and Fisheries Services, U.S Fish & Wildlife Services, etc.)
Laboratory Work: May include one or a combination of the following: • Analyses of soil samples for moisture content, particle size distribution, petroleum hydrocarbons, total or dissolved metals, volatile organic compounds, organophosphorus pesticides, etc. • Analyses of water samples for total or suspended solids, biological oxygen demand, nitrogen, sulfide, sulfate, sulfite, dissolved and total concentrations of priority pollutants, etc. • Microbiologic analyses of water or sediment samples. • Taxonomic analysis of specimens. • Chemical or genetic analysis of fish tissue samples.	• The majority of the laboratory work needed for monitoring studies is performed by outside certified laboratories under purchase orders or contractual agreements with the Ecological Services Unit or the Hydraulic Engineering Unit. • The District's Water Quality Laboratory performs physical, chemical, and biological analyses associated with water supply and treated water operations, and is not utilized for ecological monitoring activities associated with the Capital Improvement Program or the Watershed Management operations. • ESU staff occasionally performs rudimentary laboratory analysis limited to taxonomic analysis, and simple bench-top physical and chemical analyses like turbidity, temperature, dissolved oxygen, pH, and conductivity.	• None relating to conduct of laboratory work by ESU staff were found in this review.	• External laboratories used by the District must possess appropriate certifications and/or accreditations for the class of analyses they provide to the District. These laboratories adhere strictly to standard methods and practices established or subscribed to by the applicable bodies that provide the certifications or accreditations. • Internal laboratory work performed by ESU staff conforms to published scientific standards and/or to the instructions provided by manufactures of the instruments used.
Quality Assurance: "...includes quality control functions and involves a totally integrated program for ensuring the reliability of monitoring and measurement data; it is the process of reviewing and overseeing the planning, implementation, and completion of environmental data collection activities. Its goal is to assure that the data provided are of the quality needed and claimed."(1) Quality Assurance is accomplished through the clear delineation of QA/QC responsibilities and the establishment of: • Thorough training. • Protocol guidelines. • Comprehensive field and lab data documentation. • Management, verification of data reproducibility, and instrument calibration.	• The Ecological Services Unit (ESU) for the monitoring activities related to biological resources. • The Vegetation Management Unit (VMU) for monitoring of vegetation at mitigation sites. • The Countywide Watershed Programs Unit (CWPU) for hazardous materials, surface water quality, and sediment related monitoring activities. • Contractors providing monitoring services to the District.	• Written policies or procedures specifically intended to assure the quality of the data collected in the course of environmental monitoring activities by District staff were not found in this review. • Contractors providing monitoring, sample collection, or laboratory services to the District are required to have their own Quality Assurance (QA) programs which meet current industry and/or regulatory standards. However, the District does not audit these programs and has no formal way of assessing their implementation and/or effectiveness.	• Written QA standards and/or associated review and auditing protocols were not found in this review. • The ESU assures the quality of their monitoring activities through internal reviews of reports and work products, adherence to generally accepted standards for field methodologies and protocols, mentoring and training of field staff by more senior staff, calibrating field instruments in accordance with manufacturers' recommendations, and maintaining field equipment in working order. • Each specialization within ESU has their own way of double checking their data and verifying data accuracy and reproducibility. • However, these QA measures are not applied programmatically within the ESU, and District staff does not conduct periodic quality assessment audits for verifying data reproducibility, data set integrity, equipment calibration, or consistency and uniformity of the implementation of field, laboratory, and office quality control measures.

Table III – 11: Current District Framework for Environmental Monitoring Activities (Continued)

Activity Class	Organizational Units Involved	Policies and Procedures	Standards, Protocols, or Practices
Quality Control: "...refers to the routine application of procedures for obtaining prescribed standards of performance during the monitoring and measurement process; it focuses on the detailed technical activities needed to achieve data of the quality specified by the data quality objectives. Quality control is implemented at the bench or field level." (1) The goal of QC procedures is to ensure that: • Sampling, processing, and analysis techniques are applied consistently and correctly; • The number of lost, damaged, and uncollected samples is minimized; • The integrity of the data record is maintained and documented from sample collection to entry into data record; • The data are comparable with similar data collected elsewhere; and • Study results can be reproduced.	• The Ecological Services Unit (ESU) for the monitoring activities related to biological resources. • The Vegetation Management Unit (VMU) for vegetation monitoring activities related to mitigation sites. • The Countywide Watershed Programs Unit (CWPU) for hazardous materials, surface water quality, and sediment related monitoring activities. • Contractors providing monitoring services to the District.	• This review did not find written quality control (QC) policies or procedures that guide the environmental monitoring activities of the ESU, VMU, or CWPU. • Contractors providing monitoring, sample collection, or laboratory services to the District are required to use QC procedures in accordance with current industry and/or regulatory standards. However, the District does not audit the QA programs of its vendors and has no formal way of assessing the implementation and/or effectiveness of their respective programs.	• Individuals in the ESU and VMU have through the years developed their own field logs and data collection forms and have employed documentation practices that are consistent with accepted standards as cited in the relevant scientific literature. • Where applicable, ESU, VMU, and CWPU use QC protocols that are promulgated by regulatory agencies for sampling and analysis techniques and corresponding documentation. • This review did not find written District procedures for ensuring that sampling, processing, and analysis techniques are applied consistently and correctly, that the number of lost, damaged, and uncollected samples is minimized, that the integrity of data record is maintained and documented from sample collection to entry into data record, that the data are comparable with similar data collected elsewhere, and that study results can be reproduced.
Data Management: Refers to procedures and infrastructure used to input, store, manage, retrieve, and present the data generated from the field activities. "The major function of data management is to provide easy access to the collected data and related information (e.g., historical trends data, research data, model outputs, data summaries)."(2)	• The Ecological Services Unit (ESU). • Countywide Watershed Programs Unit (CWPU) • Vegetation Management Unit (VMU). • The CADD/ Geographic Services Unit (CGSU)	• This review did not find any written policies or procedures relating to environmental data management at the District. • There are no policies or procedures that address data requests to the ESU from other District units or from the public. • The collaboration between ESU and CGSU staffs is based on individual knowledge and relationships, and no related formal policies or procedures were found in this review.	• Individuals in the ESU have, of their own initiative and design, created various databases to meet some of the data management needs associated with specific projects. Others in ESU, CWPU, and VMU have kept monitoring data in project files or in spreadsheets on their own desktop computers or in their Unit's shared directory located on the District's network servers. • Staff identified the following databases currently in various stages of development and use in the ESU: o FishData: Paradox being converted to Access97; contains fish capture data, various output queries, simple table reports and outputs for electronic transfer of data to spreadsheets for charting; GIS-compatible via site location coordinates. o LoggerDeployment: Access97; Contains temperature logger data; designed to serve FAHCE project needs and incorporates rigorous QA/QC calibration checks for equipment; contains output queries for daily temperature using raw and checked data; GIS-compatible via monitoring station coordinates. o WaterChemistry: Access97; contains water chemistry data (temp., conductivity, dissolved oxygen) from water columns in District reservoirs and output queries for electronic transfer of data to spreadsheets for charting; GIS-compatible. o FishBarrier: Access97; Contains fish passage impediment locations, evaluation, ownership, and site data for ~50% of District streams below reservoirs, and various output queries and reports; GIS-compatible. o TimeBilling: Access97 (in development); intended for tracking time spent on projects. o Equipment: Access97; contains ESU field equipment inventory and maintenance records. o Wildlife: Used to store information from most wildlife surveys. o Vegetation Re-growth • Knowledge of the existence of these databases and proficiency in their use varies between ESU staff members.

Table III – 11: Current District Framework for Environmental Monitoring Activities (Continued)

Activity Class	Organizational Units Involved	Policies and Procedures	Standards, Protocols, or Practices
Analysis & Modeling In general, the goal of these activities is to "summarize and simplify the collected data, test for changes and differences, generate hypotheses, determine the consequences of observations, and evaluate the uncertainty associated with conclusions drawn from the data." (2)	• The Ecological Services Unit (ESU) • Countywide Watershed Programs Unit (CWPU)	• This review did not find any written policies or procedures relating to the analysis and modeling of environmental data at the District.	• Resources allocated to analysis activities have not been commensurate with those for data collection. • In-house databases available to ESU staff do not have built-in tools for effective and efficient analysis and modeling of data to determine uncertainty associated with measurements, classify the data into appropriate spatial and temporal strata, and test for spatial and temporal change.
Dissemination of Results These activities consist of the preparation of reports and presentations to convey the outcomes of the monitoring activities to their intended audiences for the purposes of aiding environmental management decisions and/or for education and outreach. Dissemination of results may range from reporting of results to regulatory agencies for compliance monitoring, to reports and presentations for management, stakeholders, scientific and educational forums, and the community.	• The Ecological Services Unit (ESU). • Countywide Watershed Programs Unit (CWPU) • The CADD/ Geographic Services Unit. • The Regulatory Compliance Unit may become involved in tracking and coordination of reporting to regulatory agencies on compliance monitoring activities.	• This review did not find any written policies or procedures relating to dissemination of environmental monitoring results at the District or to the community.	• Reports on results of trends and status studies are prepared as time and available resources allow. When produced, these reports may or may not get disseminated to management depending on the judgments of the project manager. Some reports are also filed with the District library. • Existing trends and status studies have not been integral to any urgent or critical decision making frameworks. Consequently according to staff, reporting on the outcomes of these studies has usually received a lower priority and limited available resources have generally been allocated to more pressing activities. • Reports on compliance monitoring activities receive more consistent attention from staff and management. However, according to staff, not all existing monitoring commitments are likely known and/or are addressed in the current budget. • Dissemination of monitoring results from studies stemming from legal proceedings is usually restricted due to "attorney-client privilege" and other considerations.

Notes:

(1) U.S. Environmental Protection Agency. May 1996. Biological Criteria: Technical Guidance for Streams and Small Rivers. EPA822-B-96-001. Office of Water, Washington, D.C.

(2) National Research Council Committee on a Systems Assessment of Marine Environmental Monitoring. 1990. Managing Troubled Waters: The Role of Marine Environmental Monitoring. National Academy Press, Washington, D.C.

III.F. Monitoring Activities Evaluation Summary

Chapter III of this report describes in details the wide range of factors that we anticipate will determine the type and quantity of District monitoring activities over the next 15 years. To summarize, the most significant findings of this review and evaluation project can be stated as follows:

III.F.1. Anticipated Expansion of Monitoring Requirements

Based on the definitions and assumptions adopted in this review, fiscal year 2001-2002 and 2002-2003 costs attributable to various monitoring activities are estimated to be in the order of approximately $2.5 million and $3.4 million respectively.

A number of mitigation compliance monitoring activities are underway and many are expected to remain active for the foreseeable future. The District is also conducting a number of special studies and surveys not directly related to regulatory compliance. These are also expected to expand and continue well into the future.

Not all historic mitigation and monitoring commitments are accounted for at this time. Recently launched efforts to identify these commitments are expected to also identify additional monitoring needs that the District will want to address over the next 5 to 10 years.

The District's environmental monitoring needs and requirements are expected to grow dramatically in the coming years in conjunction with the 15-year Capital Improvement Plan, the Multi-Year Stream Maintenance Program, stream stewardship programs, watershed management and water supply operations. Based on our projections, it is estimated that annual costs for monitoring activities at the District will grow to approximately $23 million by fiscal year 2018.

The increased costs are attributed to the following factors:

- The Multi-Year Stream Maintenance Program includes substantial commitments for monitoring activities before and during annual projects. The District has also committed to spending $5 million over the next 10 years on an extensive monitoring program for surveying and documenting the abundance and diversity of protected fauna and flora throughout the District.

- The outcome of the FAHCE process is anticipated to include an adaptive management program deploying widespread monitoring activities in the three largest watersheds within the Santa Clara Basin. The monitoring activities apparently will examine fisheries and habitat functions within the study areas, including monitoring and assessments of water quality parameters, stream geomorphology, vegetation, and SRA cover.

- There are 68 projects in the District's 15-year CIP. Based on available information in preliminary planning documents, we anticipate that roughly 38 of these projects will likely entail significant and unavoidable environmental impacts and each will probably require some degree of mitigation and monitoring. By the end of the 15-year period, it is fairly likely that the District will have accumulated commitments in roughly 30-some individual Mitigation and Monitoring Plans (MMPs).

- Each of these projects can be expected to spawn specific MMP development efforts, each incorporating a multitude of perspectives and involving a unique set of regulatory, scientific, technical, and other broad and interrelated issues. If we use the Downtown Guadalupe Flood Control Project (GRP) and Coyote Creek FCP (CCP) as examples of processes that will likely shape monitoring requirements in the more significant of the planned CIP projects, then the District can expect to engage in numerous prolonged, deliberate, and time-consuming planning and negotiating efforts. To ensure that these monitoring commitments are arrived at in ways that best address the District's interests and limitations, the planning and negotiating phases will need to proceed carefully and deliberately, requiring significant and consistent allocations of time and resources

- The commitments associated with each MMP are also expected to become more costly in future projects. Future MMPs will likely include some degree of adaptive management and each will come with its own complex set of stakeholder issues, environmental impacts; hydraulic, hydrologic, hydrogeomorphic, and stream function characteristics; mitigation and restoration objectives; environmental indicators; conceptual models; success criteria; data storage and management needs; project management needs; data quality objectives; quality assurance project plans; data collection; analyses; reporting requirements, etc.

- To the extent that the GRP and CCP are any precedents, the District can further expect the durations of these monitoring commitments to be on the order of tens of years or more, or the life of the projects. Some monitoring costs for individual projects can be expected to persist indefinitely. As a result, the accumulative sum costs only increase over time since more monitoring projects will be started while few will be completely terminated.

Collaboration with external monitoring programs will continue to play a significant role in the conduct of monitoring activities throughout the District. Currently, the District's financial contribution to collaborative monitoring efforts is estimated to be approximately $290,000. This already substantial commitment of resources is expected to grow in the coming years due to:

- Recent increases in enforcement and regulatory actions for the range of environmental laws and regulations directly applicable to District operations. Examples include the many on-going and anticipated TMDL processes, and anticipated additional listings under the endangered species acts and associated critical habitats designations.

- The prevalence of stakeholder participation and adaptive management processes in emerging environmental monitoring and oversight frameworks.

III.F.2. Management, Organization, and Effectiveness of District Monitoring Activities

Current monitoring practices and frameworks are variously modified leftovers from prior District organizational structures. The specific roles and responsibilities of the units involved in monitoring activities and regulatory compliance have not been reviewed or updated to keep pace and remain consistent with the various organizational permutations that the District experienced through a number of restructuring events over the past ten years. The units involved have adjusted previously recognized roles, responsibilities, and lines of communication for initiating and planning monitoring activities to reflect their own sense of what the most recent watershed centered re-organization implies with respect to monitoring projects.

A framework to systematically and rigorously assess and track the effectiveness and efficiency of the individual and/or collective monitoring efforts does not currently exist. Effectiveness goals, objectives, criteria, and standards have not been articulated. More importantly, the project planning, budgeting, management, and tracking practices are highly variable, and current cost tracking procedures are not designed to specifically capture and delineate monitoring-specific tasks and expenditures.

Qualitatively however, it is clear from our findings that the current management, organization, and conduct of ecological monitoring activities at the District cannot be characterized as fully effective because:

- There is no current and unambiguous assessments of the degree to which on going monitoring activities effectively comply with all outstanding regulatory requirements.
- Current activities are mostly project-specific, and results are generally not interpreted, synthesized, analyzed and presented in a format and within a context that provide meaningful answers to key questions that are integral to critical engineering and management decisions.
- Historic or on-going monitoring efforts are not used effectively to improve the quality, applicability, and efficiency of newly negotiated monitoring requirements and agreements.
- Monitoring activities are not being effectively applied towards the District's long-term strategic objective of becoming more self-regulating with respect to impacts on the water and environmental resources in its jurisdiction.

Efficiencies in the conduct of monitoring activities throughout the District also appear less than optimal.

- Coordination and communication between projects, and with and between external collaborative monitoring initiatives, are minimal and highly variable. As a result, the level of efficiency and possible redundancies, duplications, and synergies within the overall monitoring program are not easily discernible by participants or by management.
- The quality of the data collection is not programmatically and systematically assured, and the usefulness and utility of monitoring results are not maximized and ensured through uniform and consistent protocols for upfront project planning, budgeting, and scheduling, and for developing project-specific data quality objectives and data quality assurance plans.

The existing framework for the conduct, management, and integration into decision-making of environmental monitoring does not appear fully adequate or geared up to meet the anticipated growth in demands on the District's monitoring resources and capabilities.

III.F.3. Application to Needs Assessment

Our brief review of trends in environmental regulations shows how rapidly these regulations are evolving – too rapidly, in fact, to meaningfully project how these changes will affect District monitoring requirements a year or two from now. However, because of increasing focus on watershed sources of pollutants, and on the effects of pollutants in streams and reservoirs, it can be projected that these changes will profoundly affect District monitoring requirements. New pollutants of concern, new knowledge of pollutant sources, fate, and transport, and new regulatory approaches to investigating and controlling pollutants require that the District pay close attention to evolving regulations and regulatory activities.

Relevant new regulatory and scientific information is disseminated, and monitoring program designs are developed, within the context of regional monitoring collaboratives including SCVURPPP, SCBWMI, and the RMP, as well as project-specific stakeholder groups like the Mercury Council and the PCB TMDL stakeholder group. The District contributes financial support to these collaboratives, and staff participates in their various committees. However, the District lacks adequate staffing and organization to compile and analyze this information, make decisions, and respond timely. This leaves the District in a typical role of passive partner and source of funds to these collaboratives, rather than taking a leadership role. Because of the District's changing mandate, and because of increased regulatory emphasis on watershed sources and effects, this typical role may no longer be appropriate or sustainable.

Looking to the future, we see abundant indications that ecological monitoring activities at the District will continue to take on larger, more prominent, and highly complex roles in the normal operations and decision-making frameworks within the District. Recent developments and apparent trends in legal and regulatory drivers that determine the District's future monitoring needs are favoring regional approaches and longer time horizons. We also see that developments within the science, technology, and management of environmental monitoring are also tending toward more integarted analyses that require increasingly more sophisticated conceptual and analytical tools.

Given the very complex, highly dynamic, and rapidly changing nature of the environmental monitoring arena, it is impossible to accurately predict the exact monitoring needs that the District will have to contend with over the coming 15 years.

What is clear, however, is that the District can and will need to become highly competent in the conduct, management, coordination, and integration of environmental monitoring projects. To achieve this necessary level of competency, the District must put into place robust, carefully designed, adequately supported, and firmly established organizations and processes that afford the District sufficient degrees of responsiveness, resilience, adaptability, reliability, and credibility when it must design and/or adjust specific monitoring programs in response to the changing regulatory and scientific environments.

The above findings demonstrate that there is ample room and opportunity for improvements in the effectiveness and efficiency of District monitoring activities. The following chapters will examine the key factors that must be attended to and some strategies that can be adopted to achieve higher effectiveness and efficiency. The remaining sections will also present arguments for a recommended strategy, and will go on to recommend specific steps and initiatives for the District to improve the effectiveness and efficiency of its biological, surface water, stream functions, and geomorphic monitoring activities.

IV. NEEDS ASSESSMENT AND ALTERNATIVES EVALUATION

This project was spawned from rather generalized concerns regarding the status of District monitoring activities and the District's future monitoring needs, and a desire for a more comprehensive, integrated approach to monitoring. Starting from this somewhat vague, chaotic understanding, by closer analysis we developed simpler, more concrete statements, until we arrived at what we believe to be the most basic underlying condition that currently limits the efficiency and effectiveness of these activities.

Having grasped this, and having reviewed the historical development of that condition, we then started on our return journey, considering, along the way, the complex interaction of objectives, activities, and resources within the District's environmental monitoring efforts. We thereby came back to a consideration of the District's need for a comprehensive, integrated approach to monitoring, no longer as a single, generalized concept, but rather as a rich aggregate of relationships among projects and personnel.

IV.A. Needs Assessment

We developed and refined our understanding the of District's environmental monitoring needs by: (1) compiling and reviewing the initial perceptions of management and staff (together with our own observations during the course of compiling monitoring information), (2) conducting a "SWOT" session with an invited group of District staff, during which we reviewed the Strengths, Weaknesses, Opportunities, and Threats related to District environmental monitoring, and (3) Reviewing the experience of some of the environmental monitoring programs with which the District collaborates.

IV.A.1. Initial Perceptions of Management and Staff

The Monitoring Activities Evaluation Project was initiated with the following perceptions and assumptions:

- The District is unprepared to fulfill additional environmental monitoring commitments associated with recently initiated capital projects and recently negotiated regulatory and legal settlements.
- Current District monitoring activities will not enable the District to demonstrate the effectiveness of activities and expenditures under the Clean Safe Creeks and Natural Flood Protection program (Measure B).
- District monitoring activities are fragmented and poorly coordinated.
- There are opportunities to increase the overall efficiency and effectiveness of District monitoring activities.
- The District needs to develop a comprehensive, integrated approach to monitoring.

To evaluate the first concern, we compiled lists of current and planned monitoring activities (Section III.A, III.B, and III.C). This task required contact with District project managers responsible for implementing monitoring activities and the collection and review of many monitoring reports and data sets.

In the course of this effort, we observed that:

- There is no "master list" of current monitoring projects or activities (except what can be gleaned from budget documents).

- Reporting of monitoring results is inconsistent, and it is often difficult to access reports and data generated by previous monitoring projects.
- Monitoring commitments tend to serve the negotiated permit conditions or settlement conditions for specific projects.
- There is little coordination or integration of monitoring plans or monitoring effort between projects.
- Monitoring standards and techniques vary from project to project.

IV.A.2. Analysis of Strengths, Weaknesses, Opportunities, and Threats (SWOT):

IV.A.2.a. SWOT Methodology

SWOT analysis is a method for obtaining and organizing the knowledge and perspective within a group so that it can be used in strategic planning. SWOT has been used in corporate marketing, the nonprofit service sector, and among villagers in underdeveloped countries. The origins of the method are unknown.

The basic tools and structure of SWOT are to engage participants in a discussion of the strengths, weaknesses, opportunities, and threats associated with a project, organization, or other entity. Strengths and weaknesses are internal to an entity; opportunities and threats are external factors to which the entity may need to respond.

SWOT is not the same as brainstorming, where participants generate a more-or-less random list of ideas or possibilities for prioritization and action. The purpose of SWOT analysis is to isolate key issues and to facilitate a strategic approach. When dealing with complex situations in a limited amount of time, trying to address all the issues involved often does not pay off. Rather, strategic planners limit their efforts to those issues that have the most impact on the situation. SWOT analysis provides a framework for identifying these critical issues.

The principal criticism of the SWOT methodology is that it may be misused. SWOT is not a substitute for a more complex and sustained strategic planning effort, which should require more research and thought than simple, subjective identification of strengths, weaknesses, opportunities, and threats.

IV.A.2.b. SWOT Implementation and Results

We facilitated a SWOT session at the District headquarters building the morning of February 7, 2002. The 24 participants included watershed managers and support unit staff, planning and project review unit staff, and biologists in the ecological services unit. To stimulate participation and avoid unnecessary reiteration of the same points, facilitators recorded the participants' statements on a large sheet of newsprint. Following identification of strengths, weaknesses, opportunities and threats, the group briefly considered ways to use the identified strengths (or to overcome identified weaknesses) so that the District might better take advantage of the identified opportunities or respond to the identified threats. A matrix of these SWOT relationships is shown as Table IV-1.

Table IV - 1: SWOT Relationships

	Strengths Positive characteristics and advantages of the issue, situation, or technique.	Weaknesses Negative characteristics and disadvantages of the issue, situation, or technique.
Opportunities Factors, situations that can benefit, enhance or improve the issue, situation, or technique.	S-O Analysis How can strengths be employed to take advantage of development opportunities?	W-O Analysis How can weaknesses be overcome to take advantage of development opportunities?
Threats Factors, situations that can hinder the issue, situation, or technique.	S-T Analysis How can strengths be used to counteract threats that tend to hinder achievement of objectives and pursuit of opportunities?	W-T Analysis How can weaknesses be overcome to counteract threats that tend to hinder achievement of objectives and pursuit of opportunities

Toward the end of the session, each participant was asked to identify what he or she believed was the single most significant fact or statement revealed during the discussion. The session ended with a "plus/delta" evaluation, which revealed a generally upbeat and optimistic view regarding this project, mixed with some skeptical references to earlier monitoring evaluation efforts that some participants believed had not resulted in significant change.

This group's identification of strengths, weaknesses, opportunities, and threats in the District's environmental monitoring activities paralleled our own, earlier observations. However, the particular perspective of the participants – and the similarity of perspective among staff with quite different background and work assignments – made it possible to identify or validate the most critical issues.

The first, and most significant, result of the SWOT session is that participants identified the project-focused character of the District's monitoring efforts both as a strength (i.e. success in getting things done) and as a weakness (monitoring is fragmented and reactive; results of monitoring are often not used in decision-making, there is a lack of consistency in quality assurance, recording of metadata, and reporting).

A second area of common concern was that the District doesn't use the knowledge obtained from monitoring to leverage better deals when negotiating with regulatory agencies. Participants believed that the District doesn't take the opportunity to play a leading role in regional monitoring collaborations (Santa Clara Valley Urban Runoff Pollution Prevention Program, Santa Clara Basin Watershed Management Initiative, Bay Area Stormwater Management Agencies Association, Regional Monitoring Program for Trace Substances), even though the District is a significant source of funding for these efforts.

A third area of concern was the effect of the project-focused, fragmented monitoring effort on the work of the District's environmental staff. Because the adoption of new monitoring commitments is not coordinated or centralized, environmental staff lacked understanding of what their priorities should be. In addition, it was stated that environmental staff were unclear on "who the client is." This statement is notable for the implicit recommendation that District environmental professionals should have consultant relationship to other District functions, and equally notable because it shows that this relationship has not been successfully defined nor implemented.

Our analysis of the results of this SWOT session was assisted by the remark of one participant who stated: "This meeting shows that 'watershed management' is now the dog," meaning that the relationship between watershed management and flood protection has been reversed (referring to the idiom "tail wagging the dog").

From this meeting, we concluded that the basic underlying condition limiting the efficiency and effectiveness of the District's environmental monitoring activities was that environmental monitoring (and other environmental services, such as planning) -- having been fashioned to serve the needs of specific projects -- are now being redirected to serve the District's new watershed management mandate. The District organizational structure and way of doing business lags behind the policy change, and this is the root source of many, if not most, of the identified shortcomings in the District's monitoring activities.

IV.A.3. Twelve "Lessons Learned" from other Environmental Monitoring Programs

We reviewed published literature on monitoring program design and also considered the experience of several Basin-wide and regional-scale collaborative monitoring entities – the RMP, BASMAA/BACWA, SCVURPPP, and the SCBWMI – with which the District is involved.

Many issues related to the District's monitoring activities are specific to its own case (in particular, the District's geographic focus covering all surface and groundwater within a specific basin, and its multifaceted role in water supply management, flood management, and watershed stewardship within that basin). However, the history and development of the District's environmental monitoring activities is typical, in that it is responsible for a plethora of monitoring projects, each with its own objectives (defined well or poorly) and now finds it necessary to organize, coordinate, or consolidate these projects to serve a larger aim.

It is therefore worthwhile to investigate these questions: What have these groups done to improve the efficiency and effectiveness of their own environmental monitoring work? What were the results? And how might the lessons learned be applied to the District's evaluation of its monitoring activities?

In this section, we first consider the overall experience of "re-design" efforts by the RMP, BASMAA, SCVURPPP, and the SCBWMI. Then we summarize twelve of the most applicable lessons that have been learned from these re-design efforts and from the experience of planning and implementing monitoring projects through these entities.

These lessons fall into the three broad categories: program design, project design, and project management.

Program Design: Key concepts that have emerged from efforts to redesign entire monitoring programs are:

- Lesson 1: Envision monitoring as a component of a management system;
- Lesson 2: Develop collaborative relationships with stakeholders (including Federal and state

regulatory agencies, local government, and interested parties) when determining monitoring objectives;

- Lesson 3: Use indicators, organized into a framework that provides a unifying theme, to make data useful to stakeholders and environmental managers; and
- Lesson 4: Illustrate functional relationships, via conceptual models or other representations of current understanding of environmental processes, when developing frameworks and selecting indicators.

Project Design: Some lessons learned from projects designed to answer specific management questions include:

- Lesson 5: Define and implement a quality management process;
- Lesson 6: Use an appropriate statistical design;
- Lesson 7: Use standard methods;
- Lesson 8: Document sampling sites, and
- Lesson 9: Document and present the project in a final report.

Project Management: Lessons learned that relate to the management of projects include:

- Lesson 10: Promote client/consultant collaboration;
- Lesson 11: Require a scope, schedule, and budget, and
- Lesson 12: Plan for public participation and peer review.

IV.A.3.a. Overall Experience of "Re-Design" Efforts: Cautionary Tales

The District's experience as a participant in the RMP, BASMAA, the SCBWMI, SCVURPPP, and the Regional Board provides insight and cautionary lessons in embarking on a review and redesign of program activities.

- The RMP, conceived as a 5-year program in 1993, commissioned (in 1997) an independent panel of experts to review all aspects of that program. The panel recommended a "collaborative effort among all participants to provide more detailed statements of the project's overall goals; an expanded, clearer set of program objectives; a more precise set of scientific questions to be answered; and a more distinct definition of roles, responsibilities, and decision-making processes." Following up on recommendations in the panel's report, SFEI recruited workgroups to review bioaccumulation, pesticides, chlorinated hydrocarbons, and sources, pathways, and loadings. By 1999, RMP staff and participants were still considering "management questions" and "focusing questions." An interim program was put in place while the process was completed. BASMAA criticized a preliminary project list, prepared for the RMP by Regional Board staff, as unfocused and not clearly linked to the Regional Board's priorities (and most particularly not sufficiently linked to the TMDL program, which had, in the interim, become the Regional Board's top planning priority). The final, redesigned RMP will first be implemented in 2002.

- In 1997, at the request of Regional Board staff, BASMAA began development of a BASMAA Regional Monitoring Strategy. Over the next year or more, a consultant facilitated lengthy and frequent meetings with the BASMAA Board. That Board never adopted the resulting voluminous report. Eventually, a brief statement of objectives was accepted and became the basis for an annual process that reviews stormwater agencies' monitoring efforts and identifies common areas of interest.

- In 1998, stakeholders in the SCBWMI began preparation of a "framework" for conducting assessments of Santa Clara Basin watersheds. The framework, including a table of quantifiable parameters intended to indicate whether beneficial uses were met, became a subject of extended debate. The framework was not finalized until early 2000. The assessment is still underway.

- In 1999, SCVURPPP submitted to the Regional Board a "vision" of how its monitoring activities would support the SCBWMI. Portions of the "vision" were implemented in the SCBWMI's Watershed Characteristics Report (May 2000), and the same concepts were incorporated into SCVURPPP's 5-year monitoring plan (initial draft submitted March 2001). However, extended discussions with the SCBWMI and Regional Board staff were required before an uneasy consensus was achieved (in February 2002).

- Also in 1999, Regional Board planning staff developed – with assistance from SCVURPPP and BASMAA – a Regional Monitoring and Assessment Strategy (RMAS). The RMAS was intended to guide the Regional Board's assessments of water bodies pursuant to Clean Water Act Section 305(b) and to improve the technical content of Regional Board decision-making. However Regional Board planning staff has since essentially disavowed the planning role of the RMAS, saying the RMAS simply incorporated "any and all" monitoring underway.

The District's experience with the RMP, BASMAA, SCBWMI, SCVURPPP, and RWQCB verifies many of the conclusions of the oft-cited report by the National Resources Council, *Managing Troubled Waters: The Role of Marine Environmental Monitoring* (National Academy Press, 1990). That report states:

> "The lack of communication and coordination among the entities sponsoring or conducting monitoring and making environmental management decisions inhibits the proper design of monitoring programs and limits the usefulness of monitoring results. Inflexible regulatory requirements also limit opportunities to adapt programs to new needs." (p. 15)
>
> "Statutory and regulatory requirements can hinder an agency's flexibility in carrying out its monitoring requirements, lead to duplication of monitoring efforts among agencies, leave important data gaps, or commit monitoring resources to parameters or problems that are already well understood." (p. 30/31):
>
> "Because conflicting objectives are often settled through a political rather than scientific process, monitoring may ultimately not do what it is supposed to do: provide information for making decisions. Public demands may result in the constant shifting of monitoring activities so that useful information is never produced." (p. 35)

The bad news is that the re-design of monitoring programs can be prolonged, difficult, and contentious. The good news is that the District can avail itself of a wealth of lessons borne from the experience of others.

Which of these lessons are most applicable to the District? The most emphatic warning in the NRC report is that:

> *"Failure to commit adequate resources of time, funding, and expertise to up-front program design and to the synthesis, interpretation, and reporting of information will result in failure of the entire program.* Without this commitment, effort and money will

> be spent to collect data and produce information that may be useless." (p. 53/54, emphasis in original)

The District has begun this commitment of resources by initiating a review of its monitoring activities. Improving the efficiency and effectiveness of the District's monitoring activities will require far-reaching changes to insure the quality of the monitoring program's structure and processes. The needed changes extend from the relationship of monitoring to Board and management decisions, to the statistical design of individual monitoring projects, to public participation, peer review, and the dissemination of monitoring reports.

IV.A.3.b. Lessons Learned: Program Design

Here are some of the most applicable lessons learned from the re-design of multi-agency monitoring programs in which the District participates:

- Envision environmental monitoring as a component of a management system.
- Coordinate among stakeholders when setting monitoring objectives.
- Use indicators to organize environmental data.
- Illustrate functional relationships using conceptual models or other heuristic representations.

Lesson 1: Envision environmental monitoring as a component of a management system.

The most important step in envisioning an effective environmental monitoring program is to understand that monitoring should be an integral part of a management system. That is, the questions of what and when to monitor should be linked to Board and management decisions and actions. As discussed earlier in Section III.D.10.a, this process has been described as "adaptive management" and can be summarized as a cycle where decision-makers:

Evaluate → Plan → Act → Monitor → Evaluate →

The authors of the 1990 NRC developed "Ten Steps to Strengthening the Role of Monitoring in Environmental Management" (see box). The overall thrust of these "ten steps" is to make monitoring part of this loop; i.e. monitoring should serve the needs of decision-makers, and decision-makers should define the questions that monitoring must answer (rather than responding to the results of monitoring efforts selected by others).

The District's monitoring program should be integrally tied to the Board's ends policies (and management strategies to implement those policies) and to the District's efforts to fully comply with environmental regulations. One way to begin accomplishing this is to insure that all monitoring project plans include a clear statement of why the data collected is required to implement these objectives.

NRC 1990 p. 37: Ten Steps to Strengthening the Role of Monitoring in Environmental Management

1. Clear guidance is necessary on how data are to be used and what type of decisions are to be made.
2. The goals established should be achievable scientifically, technologically, logistically, and financially.
3. The monitoring program should be integrated into the decision-making system, with decision points and feedback loops clearly established before the data are collected.
4. Where authority and control reside should be made explicit. Fiscal controls should be compatible with program controls and objectives.
5. Channels of communication among agencies and other participating individuals and groups should be identified and efforts made to ensure that the channels are interconnected and functional.
6. The monitoring program should integrate the regulatory, data, and management needs and responsibilities of the local, state, regional, and federal agencies to optimize the use of available resources.
7. Viable mechanisms should be established to involve the public and the scientific community as program participants early and often.
8. The monitoring program should include built-in mechanisms to ensure tht its conclusions are communicated to decision makers and the public in terms that they can understand and act upon.
9. Monitoring programs should include mechanisms for periodic review and easy alteration or redirection of efforts when monitoring results or new information from other sources justifies a change.
10. The management action to be taken in response to both the expected results and unexpected but possible outcomes should be identified in advance.

Lesson 2: Coordinate among stakeholders when setting monitoring objectives.

Dozens of local, state, and Federal agencies, environmental organizations, and others monitor Santa Clara Basin creeks and San Francisco Bay. The collaborative monitoring efforts in which the District currently participates are described in Section III.B. To reiterate the points made earlier, communication and coordination is essential to avoid duplication of effort and to insure that environmental management strategies are complementary.

In particular, in developing monitoring programs and projects, the appropriate District staff needs to share and discuss monitoring plans and results within groups such as the RMP Steering Committee and Technical Review Committee, the BASMAA Monitoring Committee, the California Bioassessment Workshop, SCBWMI Watershed Assessment Subgroup, and others.

Most importantly, this sharing, discussion and coordination should be integrated with the District's program planning and project planning. Simply sharing results or providing updates on project progress does not serve this need; a truly collaborative relationship with other groups is required.

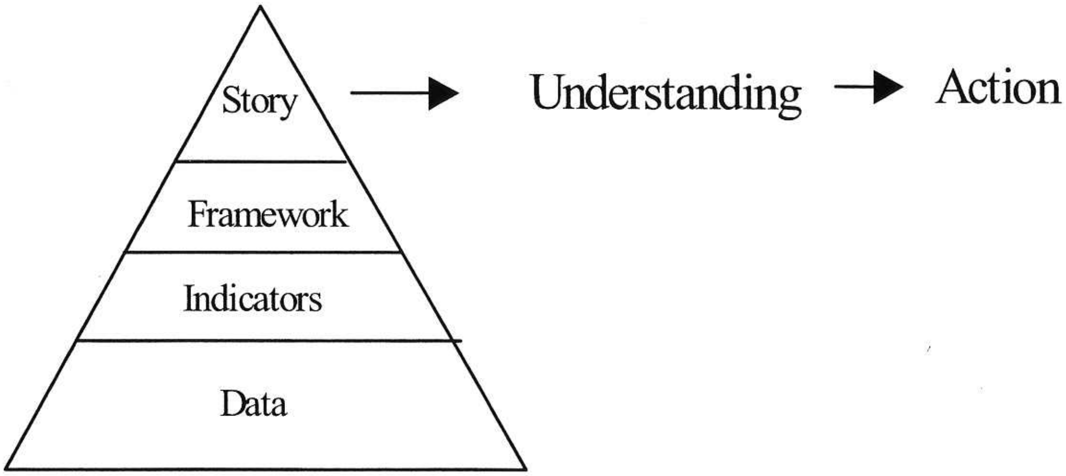
Lesson 3: Use Indicators to Organize Environmental Data

A brief discussion of environmental indicators and their selection is presented in section III.D.10.c.

In 1998 through 2000, the District, through SCVURPPP, implemented a 2-year, $560,000 study to test 20 stormwater environmental indicators proposed by the Center for Watershed Protection.

The study concluded that physical indicators (stream widening and downcutting, physical habitat monitoring), and biological indicators (macroinvertebrate and fish assemblages) were useful in assessing overall watershed condition. However, it was also determined that, to successfully link the indicators to management actions, it was necessary to organize them into a framework that reflected an understanding of the relationships among urbanization, watershed imperviousness, hydrologic and hydrogeomorphic effects on streams, habitat quality, and aquatic communities.

A general example of how indicators can be used to inform the public and to galvanize stakeholder action is illustrated by the "Index of Silicon Valley" published by Joint Venture: Silicon Valley (JVSV), the business/ government collaborative that seeks broadened prosperity, livable communities, and civic engagement. Kimberly Walesh of Collaborative Economics (consultant to JVSV) has illustrated the role of indicators in promoting decision-making and action. See Figure IV-1.



Figure

IV - 1: Relationship of Indicators to Action

According to Walesh, each of these elements (data, indicators, framework and story) is necessary, because:

> Without a compelling, well-communicated story, it is difficult to catalyze action.
> Without an organizing framework to provide a unifying theme, it is difficult to choose a consistent set of indicators.
> Without indicators that organize the data, the data are impenetrable.
> Without timely, relevant data, a story's significance is dramatically reduced.

To prepare their annual "Index of Silicon Valley," JVSV works with existing economic data from local firms. However, this process of organizing data into indicators, indicators into a framework, and developing a narrative that describes problems and potential solutions is also applicable – when used in reverse – to guide data collection efforts.

That is, before collecting data, it is necessary to:

Draft a "story" (i.e., a problem statement) that posits an environmental problem to be investigated or solved,
Create a framework (e.g., a conceptual model) that provides structure for the various elements of the story, and
Identify indicators that will consistently contribute to the unifying theme.

The process of defining a framework and identifying appropriate indicators makes it possible to use environmental monitoring as a component of an environmental management process. Without such foresight, and without a structured methodology for implementing it, most environmental data will not be used effectively in decision-making.

Lesson 4: Illustrate Functional Relationships Using Conceptual Models or Other Heuristic Representations

A general discussion of conceptual models and their application in environmental monitoring is presented in section III.D.10.b. The following is further elaboration on that element in the context of lessons learned applicable to the design of monitoring programs at the District.

Conceptual models are one kind of framework that can provide a unifying theme conducive to stakeholder understanding and problem-solving. Stakeholder participation in the South Bay Copper/Nickel TMDL and ongoing efforts in the Bay Mercury TMDL, Guadalupe Mercury TMDL, and Bay PCB TMDL show the importance, and the effectiveness, of developing conceptual models before contemplating what data should be collected through a monitoring program.

A conceptual model illustrates current understanding of the causal links that make up an environmental problem, e.g., pollutant sources and sinks, interactions between water and sediment, and pathways to bioaccumulation.

For example, a model of selenium cycling in San Francisco Bay (Figure IV-2) by a San Francisco Estuary Institute Workgroup, shows agriculture and refineries as the principal sources, and also shows how different species (selenate, selenite) are transformed, transported, and taken up by clams, which are eaten by diving ducks, bottom feeding fish, and invertebrates.

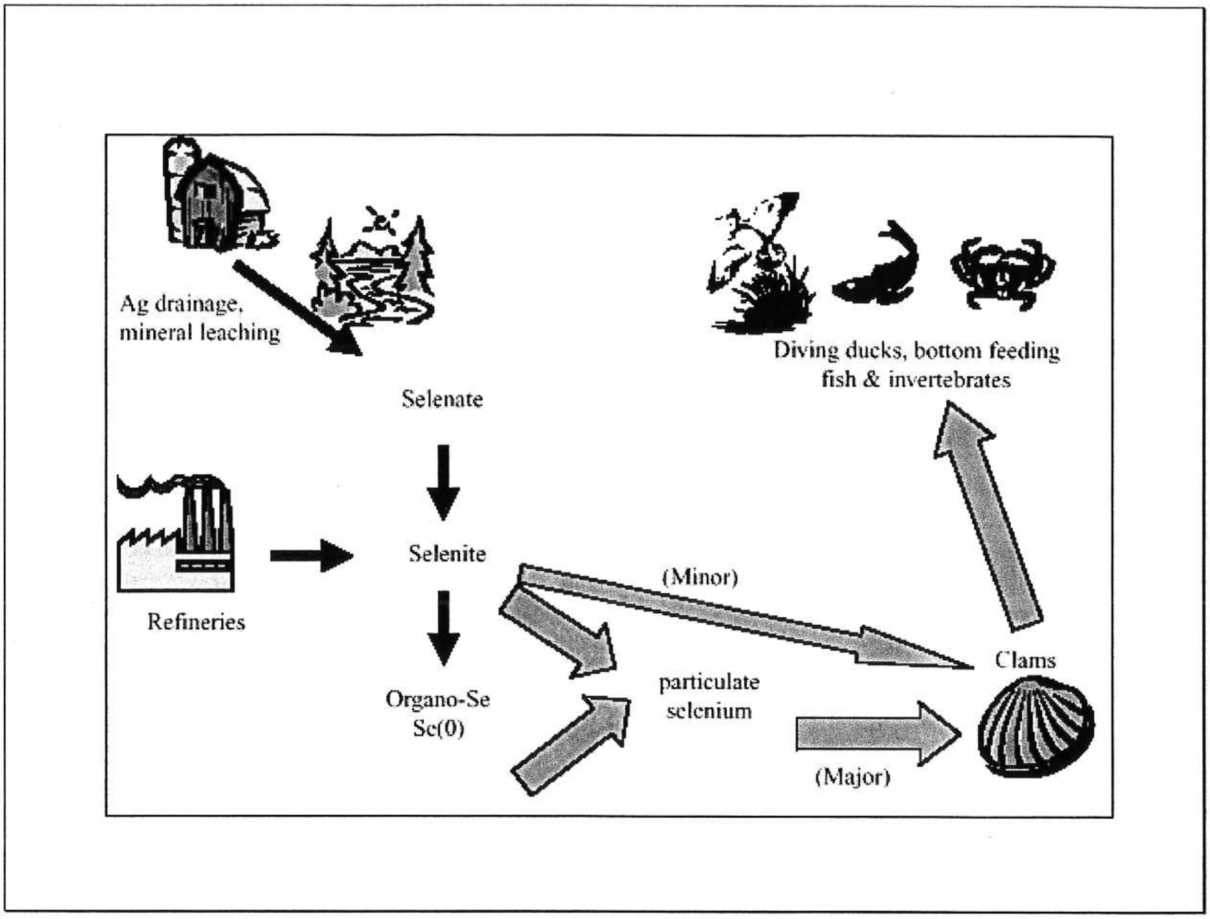


Figure IV - 2: A model of Selenium cycling in San Francisco Bay

As another example, Figure IV-3, from *Stream Corridor Restoration: Principles, Processes, and Practices* (Federal Interagency Working Group 1998) illustrates the causal chain that links changes in land use, changes in hydrology and geomorphology, changes in sediment and habitat, to changes in the populations of target species. Without such an illustration, it can be difficult to understand and communicate why an integrated approach to managing stream corridors is necessary (and monitoring at each link in the causal change is needed) to successfully stabilize or restore the populations of macroinvertebrates or fish.

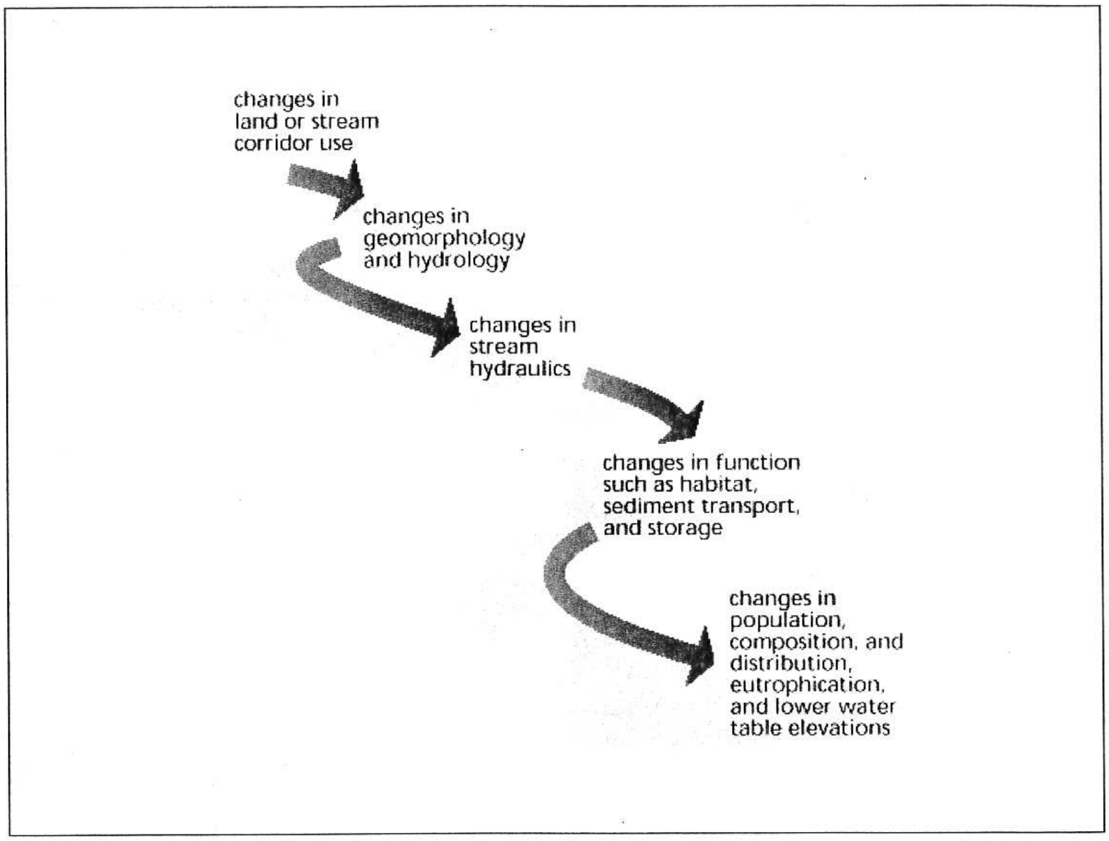

changes in land or stream corridor use
changes in geomorphology and hydrology
changes in stream hydraulics
changes in function such as habitat, sediment transport, and storage
changes in population, composition, and distribution, eutrophication, and lower water table elevations

Figure IV - 3: Conceptual model linking changes in land use to changes in populations of target species in affected streams

A conceptual model may be refined and elaborated, as necessary, into a more rigorous and quantitative model, e.g. a mass-balance model that might estimate pollutant inputs and outputs, rates of sorption, sedimentation, resuspension, and desorption, and uptake by plants or algae.

Development of a conceptual model will usually reveal unknowns that must become known before the problem can be understood well enough to guide management actions. For example: is urban runoff a major or a minor source of PCBs (or mercury) to San Francisco Bay?

Conceptual models are useful to monitoring design because they can illustrate which causal links are uncertain or unquantified.

Conceptual models can also be used to identify relative levels of uncertainty in each causal link and to examine how this uncertainty might affect the assurance of outcomes under different management scenarios.

For example, a conceptual model for mercury in San Francisco Bay might include mercury sources (mine tailings, urban runoff, POTWs, air deposition), mercury transport and deposition, transformation of inorganic mercury into methylmercury, uptake, bioaccumulation, and finally, presence in fish tissue. After considering how uncertainties in each of these parameters might affect the uncertainty of the final result, we may decide that (for example) the uncertainty in our rough estimate of urban runoff loadings is acceptable, but that additional data are needed to reduce the uncertainty of our estimate of transformation rates.

SCVURPPP's Integrated Assessment of the Coyote Watershed provides another example of a framework, one adapted for the rapid and efficient investigation of beneficial uses of urban streams. The framework stresses linkage of stream hydrogeomorphic functions (movement of water and sediment) to habitat functions and how these functions support aquatic life beneficial uses.

To implement this framework, stream reaches are first classified based on readily discernible breaks in channel slope, changes in channel form and widths, location and type of channel modifications, alterations to flow regime and regional differences in geology, climate, and vegetation.

The second step in the integrated stream assessment framework is to inventory management operations, activities, and projects (e.g. dams, diversions, reservoirs, percolation facilities, mining activity, stormdrains, land use and development, etc), which may impact or degrade stream quality and to identify which reaches of the watershed may be are affected. In addition, planned projects, activities, or resource management changes/policies (e.g. restoration projects, streamflow augmentation, development setbacks, grazing policies) are also documented.

The stream classification and the inventory of management activities can be used to make a preliminary evaluation of habitat quality in each stream reach and to project future quality based on current trends and activities. The results of this evaluation and projection are used to identify data gaps and to prioritize additional monitoring and assessment in the watershed. In addition, this process is likely to reveal specific, practical management measures that watershed stakeholders can begin to implement.

Conceptual models and the integrated stream assessment methodology are heuristic; in each method, an essentially speculative formulation (e.g., regarding sources, pathways, and loadings, or regarding stream quality) serves as a guide in the investigation and eventual solution of a problem.

These heuristic methods formalize and systematize a pragmatic approach to monitoring design. A pragmatist says our beliefs are really rules for action, and asks of every proposition: "What difference would it make?"

Such a perspective is required if monitoring activities are to serve management needs in an efficient and effective manner.

IV.A.3.c. Lessons Learned: Project Design and Quality Management

Given a monitoring program that is designed as an integral component of an environmental management system, and that has pursued a pragmatic, heuristic approach for setting monitoring priorities, the next step is to insure that projects within that program are designed so that specific questions (hypotheses) are posed clearly and succinctly, that the data collected contributes to answering those questions, and that the quality of the data is sufficient to insure that the answers are well founded and supportable (within reasonable bounds of probability).

Quality Assurance Project Plans (QAPPs) are required for USEPA-funded projects, and USEPA recommends them for all monitoring projects. EPA Guidance for Quality Assurance Project Plans (EPA QA/G5, 1998) provides detailed guidance on the preparation of QAPPs. The guidance links environmental decision-making to quality assurance as follows:

> "In order to obtain environmental data for decision making, a project should be conducted in three phases: planning, implementation, and assessment. The first phase involves the development of Data Quality Objectives (DQOs) using the DQO Process or a similar structural systematic planning process.
>
> "The DQOs provide statements about the expectations and requirements of the *data user* (such as the decision maker). In the second phase, the QAPP translates these requirements into measurement performance specifications and QA/QC procedures for the *data suppliers* to provide the information needed to satisfy the data user's needs. This guidance links the results of the DQO Process with the QAPP to complete documentation of the planning process. Once the data have been collected and validated in accordance with the elements of the QAPP, the data should be evaluated to determine whether the DQOs have been satisfied."

There is no need to repeat USEPA's specific requirements and rationales here; however, the following issues are of particular significance and may bear on the organization and staffing of the District's monitoring efforts:

Define and Implement a Quality Management Process
Use an Appropriate Statistical Design
Use Standard Methods
Document Sampling Sites
Document and Present the Project in a Final Report

Lesson 5: Define and Implement a Quality Management Process

A first step in improving the efficiency and effectiveness of monitoring projects the District pursues or funds is to require an appropriate data quality objective process or similar "structural systematic planning process" that is responsive to management needs. This process should be documented in a QAPP or similar document that is reviewed prior to data collection.

Lesson 6: Use an Appropriate Statistical Design

Aquatic environments are inherently variable, but management decisions must be based on a data from a limited number of samples. How well will the samples collected by our monitoring effort represent the water body (or segment, or stream reach) as a whole? And how many samples would be required to detect a difference between one segment or another, or one time and another? (How well can we determine differences, for example, between locations closer to or further from a suspected pollutant source, or at the same location before and after management measures are implemented)?

For example, sampling and analysis of storm water quality during 1990-1996 (the District managed this effort on behalf of SCVURPPP's predecessor) was sufficient to characterize the range of pollutant concentrations in creek waters during storms (and to compare these concentrations to regulatory objectives). However, because pollutant concentrations are variable, and the number of storms that can be sampled is limited, this methodology proved inadequate to determine potential year-to-year trends in pollutant concentrations. The design of RMP's "status and trends" monitoring in San Francisco Bay has a similar limitation.

The ability of a particular monitoring methodology to answer questions regarding differences between locations and times, or to detect spatial and temporal trends, can be predicted by reviewing the statistical power of the design. Statistical power is formally defined as "The probability of rejecting a false statistical null hypothesis." (Statsoft, 2001) That is, a project with adequate statistical power should enable management to be reasonably certain that (for example) a measured increase in macroinvertebrate diversity is due to increased stream flow, or that higher pollutant concentrations in creek sediments are related to the presence of storm drains, and that these are real effects, i.e. the measured differences are not due to chance.

Lesson 7: Use Standard Methods

The use of standard methods for sampling and analysis greatly facilitates quality assurance for the following reasons: First, certified environmental laboratories follow established quality assurance/quality control (QA/QC) procedures to maximize precision and minimize the potential for laboratory error. Second, the procedures can be thoroughly documented by reference, minimizing the potential for omission and error in describing methods. Third, standard methods have already been tested for repeatability. Fourth, use of a current standard method insures the use of the most up-to-date, proven techniques in a rapidly evolving field.

In addition, the use of standard methods improves the likelihood that the data can be used for comparison with other studies, particularly temporal studies.

The District's ability to select, use, and adapt standard methods is facilitated by collaboration with other monitoring programs. For example, the recent joint stormwater agency project to sample PCBs and mercury in storm drains used RMP methods; where specific methods had to be adapted, this was done in collaboration with RMP scientists and Regional Board staff. SCVURPPP's recent assessment of stream habitat, fish, and macroinvertebrates in Coyote Creek benefited from collaboration with biologists from USGS, USEPA, and local universities, as well as with the District's ecological services unit.

Lesson 8: Document Sampling Sites

Another difficulty that frequently arises in temporal studies is the need to relocate and re-occupy a sampling site. Too often, the only documentation provided is rough distance from a stream overcrossing or other landmark and a general description of the surroundings. Today, with the availability of digital cameras, global positioning systems (GPS), and GIS maps, it is relatively easy to insure that future researchers will be able to pinpoint the same site. One remaining issue is to insure that this documentation is not separated from the rest of the project data (see below).

Lesson 9: Document and Present the Project in a Final Report

A too-common illustration of management failure in a monitoring project is seen when the project results consists of a folder of field notes, or a spreadsheet of data, located somewhere in the project manager's cubicle or computer and accessible only through him or her.

Much is made of the need for "data management;" however, even the most sophisticated, user-friendly, accessible, and thoroughly backed-up database cannot substitute for a well-written project report.

The project report makes the project useful in management decision-making and to future researchers, and makes it possible to coordinate the results of the project with other environmental monitoring and investigations within the District and through other agencies.

The quality and thoroughness of the project report will determine whether it is possible, for example, to reach consensus on the adequacy of the data and validity of conclusions, or to examine methods used and verify that data is comparable with data collected at a different time or location.

Many standards for project reporting exist, but the basic structure and contents is consistent in all academic and professional work, consisting of introduction and background, statement of objectives (this should include the specific management questions addressed by the project), methods used, results obtained, discussion, and conclusions.

Up until a few years ago, the costs of reproduction and limitations of shelf space meant that only a few copies of technical reports (and particularly of voluminous appendices) would be produced and kept available. Consequently, research into an environmental issue would often mean hunting through dispersed libraries and interviewing researchers and agency staff. Today, there are no financial, technical, or practical barriers (only bureaucratic and organizational hurdles) to making electronic copies of the full reports, including formerly voluminous material such as photographs of sampling sites and tables with GPS's locations, available to anyone at the click of a mouse.

IV.A.3.d. Lessons Learned: Project Management

The experiences of the RMP, SCVURPPP, SCBWMI, and BASMAA/BACWA show that, in addition to designing monitoring programs so that they serve management needs, and in addition to "designing in" the technical quality of monitoring projects, skilled project management is required to insure the quality, timeliness, and cost-effectiveness of the monitoring effort.

The major "lessons learned" in the management of monitoring are: (1) Promote client/consultant collaboration (2) Require a scope, schedule, and budget, and (3) Plan for public participation and peer review.

Lesson 10: Promote client/consultant collaboration

The key organizational requirement for designing and implementing a successful monitoring project is to have clearly defined roles for each participant and to foster productive interaction between them. These relationships can be difficult and even contentious, or they can be creative and rewarding, depending on the skill of the consultant and the willingness of the client to enter into a collaborative relationship.

By "client" we mean the party that originates the monitoring project and ultimately determines if its requirements have been satisfied. Translating the experience of these regional efforts to the District's monitoring activities, the "client" might be the staff of a regulatory agency, the manager of a District capital improvement project or a District CEQA review, or the District's Board or management.

By "consultant" we mean the party responsible for implementing the monitoring project and for insuring that the client's needs have been satisfied.

Successful collaboration begins when these parties work together to understand the client's needs and to formulate management questions that can be answered through monitoring activities. Combining their different perspectives and skills, the client and consultant move from vaguely defined needs such as: "Tell us if our streams are improving," or: "Are PCBs a problem?" to more specific and answerable management questions such as: "Has increased stream flow and revegetation improved the quality and extent of habitat for salmonids in this reach?" or: "Where, and how frequently, does the PCB content of stream sediments exceed screening thresholds?"

Facilitation of this step – and the next steps where project objectives are defined and methods selected – is central to the monitoring project manager's role. This role is distinct from that of technical experts (e.g. stream biologists and environmental chemists), with whom the monitoring project manager must also have collaborative relationships.

Lesson 11: Require a scope, schedule and budget

After the project objectives are defined, the client/consultant collaboration continues, but the monitoring project manager takes responsibility for the successful completion of the project and the delivery of the project reports.

The monitoring project manager's ability to fulfill these responsibilities depends on a clearly defined scope, schedule and budget. For District projects that are implemented by outside consultants, the scope, schedule and budget are attachments to a services contract. Monitoring projects that are implemented "in-house" do not require legal review, but the same "contractual" relationship needs to be documented. That is, the agreement between the internal "client" and "consultant" still needs to be clearly understood and formalized in a scope (or project plan), a schedule with milestones for completion, and a budget (in hours, plus expenses) broken down to an appropriate level of detail for each task.

Lesson 12: Plan for peer review and public participation

The RMP, BASMAA, SCBWMI, and SCVURPPP all incorporate processes for peer review and public participation.

Peer review is best implemented through a technical advisory committee or work group with staff support. The review can be more or less formal, but always requires a substantial amount of timely work on the part of participants. As a participant in these regional entities, the District may be able to request the RMP Technical Advisory Committee (or various working groups, such as the Sources, Pathways, and Loadings Work Group), the BASMAA Monitoring Committee, the SCBWMI's Watershed Assessment Subgroup (or other subgroups), and SCVURPPP's Monitoring Ad-hoc Task Group to review project documents. Selection of the most appropriate group depends on the relevance of the District's project to that committee or group's current work.

Meetings of each of these committees and groups are open to the public, and various interested parties receive notification of upcoming meetings, along with agendas and materials for review. Therefore, release of information through these groups is tantamount to public release.

Some of the benefits the District could obtain from requesting that monitoring reports and other documents be reviewed by these committees or groups are:

Enhancing quality assurance by obtaining expert review, by those currently working in the field and in the same geographic region, of the objectives and methods of District projects.
Information regarding similar or overlapping efforts, which could enhance efficiency, avoid duplication, and save costs.
Collaboration on new or enhanced methods; thereby, facilitating standardization and improving the applicability of the data.
Opportunities to reciprocate by reviewing other agencies' work, thereby providing additional training for District staff.
A better understanding, on the part of other agencies and the interested public, of the District's monitoring efforts.

In addition to project-specific reports, each of these entities also produces (and invites comments on) annual summaries of their completed reports and planned activities.

The opportunity for peer review and collaboration with other agencies is another reason for requiring a scope and schedule that link interim products to project milestones. For example, for any given project, District staff may find it worthwhile to solicit review and comment on:

A 1-page project concept.
A project scope.
A Quality Assurance Project Plan
Interim task reports or technical memoranda
The project final report

In addition to collaboration and peer review, the experience of the RMP also shows the advantage of investment in public outreach materials. The RMP also produces an RMP Newsletter and the annual Pulse of the Estuary report. These periodicals help make technical information and technical work more accessible to the general public.

Some of the District's monitoring effort supports capital projects or larger programs; for these, monitoring plans and results are publicized through public participation plans related to those projects or programs. For District monitoring projects that have broader aims (e.g. the Surface Water Quality Improvement Program, or routine measures of stream quality), it may be useful to incorporate, as part of the project plan, the preparation of brief reports and summaries for the non-technical reader.

IV.A.4. Analysis of factors inhibiting efficiency and effectiveness.

What inhibits the efficiency and effectiveness of the District's environmental monitoring?

Clues can be found from various sources:

- Managers in the Watershed Management Division told us that monitoring data was inaccessible, or didn't provide the information they needed to be effective watershed stewards.
- Participants in the project SWOT session spoke of fragmented, project-focused monitoring, a reactive approach to environmental compliance, and new commitments being made without apparent knowledge of existing commitments or of staff resources.

- We were unable to find, for our analysis, organized or comprehensive lists of what monitoring projects have been accomplished or what reports are available.
- There are no District-wide standards for project design, for quality assurance/quality control, or for reporting the results of environmental monitoring.
- "Lessons Learned" from national experience in environmental monitoring – particularly regarding a "failure to commit adequate resources of time, funding, and expertise to up-front program design and to the synthesis, interpretation, and reporting of information" seemed to ring more and more true as our investigation proceeded.

Why do these shortcomings exist? What caused them? Why haven't they been addressed before?

The heart of the problem is this: The District's needs are changing, and have been changing for some time. Monitoring activities must change to meet the new needs.

For most of its history, the District's focus was on flood control – more specifically, on the design, construction, and maintenance of flood control projects. Permit applications and EIRs were prepared as part of the planning and design phase for each project. Monitoring and mitigation plans were likewise project-specific.

The District's project-focused style of work was both effective and efficient for getting flood control, water supply, and infrastructure projects built.

As environmental awareness increased, the District became the target of lawsuits seeking to change the way it was building, operating, and maintaining its facilities. Regulatory agencies threatened to withhold permits the District needed to remove accumulated sediment and vegetation from its floodways.

The District's response to these challenges was also project-focused. Each settlement process – the Fisheries and Aquatic Habitat Collaborative Effort (FAHCE), the Stream Maintenance Program (SMP), the Natural Resources Damage Assessment (NRDA), and others -- generated its own program for environmental mitigations and environmental monitoring. Having separate projects for each was an effective and efficient way to achieving legal and regulatory settlements. But the project-by-project approach left the District with a plethora of disparate, sometimes overlapping, monitoring requirements.

At the same time that monitoring activities were expanding project-by-project, settlement-by-settlement, District management was moving toward an overall strategy of integrated, watershed-wide stewardship.

The District's participation in the Santa Clara Basin Watershed Management Initiative, the November 2000 "Clean Safe Creeks and Natural Flood Protection" parcel tax vote, the organization of the District's Watershed Management Division, and the August 2001 revision to the Santa Clara Valley Water District Act have propelled the District toward entirely new strategies for managing floods while also protecting, enhancing, and restoring streams, riparian corridors, and natural resources.

The organization and style of work that was effective and efficient for completing individual projects is proving inadequate for the requirements of watershed stewardship.

New management objectives and new management strategies must be supported by new ways of collecting, interpreting, and presenting information. The District has long been able to monitor and analyze rainfall, runoff, and stream flow throughout the watershed. These capabilities are needed to support the design, operation, and maintenance of dams and flood control channels.

Now, the District must develop the capability to monitor and analyze stream habitat, riparian corridors, and natural resources, so that it can design, operate, and maintain its facilities to meet new objectives.

This represents a wholesale change in the way that the District uses environmental monitoring data. In the past, environmental monitoring was conducted to meet permit requirements, to comply with EIR certifications, or to help settle lawsuits. The District collected the data, but the data was interpreted and used (if it was used at all) by regulatory agencies or (more recently) by project-specific adaptive management teams. In the future, the District will collect, analyze, and present environmental data principally to answer its own management questions and serve its own management needs. Instead of responding to specific mandates imposed from outside, the District will gather and use data to understand and manage watersheds as a whole.

In our analysis, most of the shortcomings affecting the efficiency and effectiveness of the District's environmental monitoring activities stem from the contradiction between the District's new mission of watershed stewardship (on the one hand) and the project-focused organizational legacy of its previous focus on flood control (on the other). Here are some specific examples of how weaknesses (quoted here as they were identified by District staff during the SWOT session) are attributable to this contradiction:

- "No structure for regulatory negotiations related to monitoring program design." In the past, as permits and CEQA approvals for individual projects were negotiated, there was only limited consideration of previous commitments for mitigation and monitoring, even in the same watershed. There was no overall strategy that would streamline permits and approvals for future, related projects and activities. Now there is a trend to consolidate activities and negotiate program-wide approvals (e.g., the 10-year Stream Maintenance Program EIR). However, there is a need to insure that negotiated mitigation and monitoring plans for individual projects – including capital, operations and maintenance, and legal/regulatory projects – are part of a comprehensive regulatory compliance strategy that includes long-term watershed monitoring.

- "Existing knowledge is not used in designing monitoring projects." Because of the project-by-project mode of organization, the results of previous and ongoing monitoring is compartmentalized and has never been integrated and presented in a way that can be comprehended and used in the design of future monitoring. Also, there is no process that requires new monitoring projects to be consistent with, and add to, the accumulated results of past projects.

- "Don't track monitoring commitments over time." Because the overall monitoring burden is accumulated project-by-project – and because project responsibilities are separate from management of the ecological monitoring staff – there has been little incentive to adjust monitoring requirements and schedules to match availability of staff. Conversely, because assignments have been ad-hoc, to meet the needs of projects, the burden on monitoring staff is not well documented.

- "Environmental staff is unclear on 'who the client is.'" As the District is in transition from the previous project-by-project orientation to comprehensive, watershed-based environmental monitoring, staff can feel that torn between the immediate need to be responsive to individual project managers and their ability to report to management on the condition of the watershed as a whole. There needs to be leadership and direction of how the transition is being accomplished and how, in the meantime, these competing needs should be balanced.

- "Inconsistent methodologies and procedures. In the past, monitoring methods have been tailored to the needs of each individual project. However, to make this data useful for watershed management, data sets must be comparable and therefore consistent as to methods employed."

- "Data is not transformed into information and reported." Most permits or EIRs state monitoring requirements, but rarely described how the data is to be compiled into indicators or how the indicators are to be interpreted in making management decisions. Even where an adaptive management process is incorporated into the project design, it is not always clear how monitoring results will contribute to that process. In particular, there is typically little consideration of the work required to interpret and communicate results to various technical and non-technical audiences. The District's new watershed stewardship objectives will require new emphasis on integrating and reporting the results of District monitoring.

- "Lack of participation and influence in regional monitoring collaboratives." Although the District helps finance SCVURPPP, BASMAA, and the RMP, its participation in setting the direction of these collaborative monitoring efforts is indirect and sporadic. Because District monitoring activities have been primarily directed at meeting the regulatory requirements associated with specific projects, there has been little need to integrate the District's monitoring with that being done region-wide. However, regulatory trends dovetail with the District's shift to watershed management to impel more District involvement in regional efforts. For example, the Regional Board's recent emphasis on TMDLs has focused attention on non-point source pollutants, such as PCBs and mercury, that enter southern South San Francisco Bay from the District's watersheds. The District needs to respond by working with the scientific and regulatory community to better understand the sources, fate, and transport of pollutants within the watershed. As another example, approaches to biological assessment of streams are being developed and standardized statewide through the California Bioassessment Workgroup (sponsored by the California Department of Fish and Game).

IV.B. Alternatives for Improving Effectiveness and Efficiency

Our project began with the perception that a "comprehensive, integrated approach" to monitoring was required. Now, having examined District monitoring activities and commitments, the process by which monitoring projects are created and objectives defined, having surveyed the regulatory issues and trends which may shape District monitoring projects in the future, having obtained structured input from internal staff and examined the experience of other monitoring programs, and having identified the principal factor limiting the effectiveness and efficiency of the District's monitoring activities –the now-outmoded project-centered organization of those activities – we concur that a "comprehensive, integrated approach" is indeed required. However, we are now prepared to consider what such an approach may entail given the specific history, needs and organizational structure of the District's environmental monitoring activities.

IV.B.1. Overall Approach

We considered three alternative strategies for achieving a "comprehensive, integrated approach" to the District's environmental monitoring. The three alternatives are based on different approaches to serving the different needs of project permitting and watershed management. The first two alternatives examine the extremes of complete integration vs. parallel implementation; the third alternative is presented as a way to reconcile the two aims.

Alternative #1: Dismantle existing monitoring efforts and reassemble into a unified, consistent program.

Under this alternative, a new, comprehensive program would serve watershed management needs and measure progress toward the Board's ends policies. The comprehensive program would also incorporate the needs and objectives of all the current monitoring projects listed in Table xx. However, these needs and objectives would be achieved through a new set of monitoring parameters and protocols, which would be consistent throughout the unified program. As the new, comprehensive program was put in place, the existing monitoring studies would be terminated and their budgets transferred to the new program.

Two advantages of this strategy are: (1) a potential for substantial cost savings via economies of scale, consistency in implementation, and eliminating duplication of effort; (2) accelerated implementation of a unified program that serves watershed management needs and also serves individual projects.

The disadvantages of this strategy include: (1) It would require renegotiation of regulatory permit requirements; (2) the resources required to implement and manage such a large effort; (3) disruption and potential loss of continuity to current monitoring projects.

Alternative #2: Continue existing monitoring projects and create a new program specifically to serve the needs of watershed management.

This alternative is similar to what was proposed in association with the Natural Resources Management Program (February 2000). A new monitoring program would be created, specifically tailored to the needs of watershed management. Existing monitoring projects would continue to be initiated and managed as they are now.

The advantages of this strategy are: (1) The new monitoring program could be designed on a blank canvas, i.e. there would be no objectives competing with the principal aim of characterizing watershed processes and reporting on the progress toward the District's ends policies. (2) In time, the District would become more knowledgeable about conditions in the watersheds, and this would help to reduce the amount of monitoring required in connection with regulatory permits and legal and regulatory settlement agreements.

The disadvantages of this strategy include: (1) Additional costs of the new program without any offsetting by eliminating existing monitoring projects; (2) the existing duplication of effort and lack of coordination would be exacerbated, and (3) It would not provide improvement of service to existing projects.

Alternative #3: Organize and coordinate District monitoring activities to serve the needs of watershed management, while enhancing service to individual projects.

Under this alternative, a set of watershed indicators would be developed that draws largely from data that is already being collected for current monitoring projects. Additional monitoring projects would be initiated where necessary to support a well-rounded and well-designed suite of indicators. Emphasis would be placed on organizing and reporting indicators to maximize the usefulness of data in management decision-making.

Future monitoring projects, including those negotiated as conditions of regulatory permits, would be designed in connection with an overall strategy for regulatory compliance. New monitoring activities would be designed, wherever possible, to support existing indicators or new indicators that would complement the existing suite of indicators. A quality assurance process would be integrated into the design of new projects to insure that new data was (to the extent practicable) comparable with existing data sets.

The advantages of this strategy are: (1) A focus on improving service to project managers for capital improvement projects and settlement agreements; (2) Maximizes use of existing monitoring projects and monitoring commitments and minimizes the cost of collecting new data to support watershed management needs; (3) Seeks to make the District's investment in monitoring contribute to its objective of regulatory compliance, potentially reducing the extent and cost of future monitoring commitments.

The disadvantages of this strategy are: (1) The objectives to improve service to project managers and serve the needs of watershed management may compete, blunting the effectiveness of the strategy; (2) the long-term needs of watershed management may not be served by the shorter-term commitments related to specific projects.

Under a potential fourth alternative, the "no project" alternative, no changes would be made to District monitoring activities. We did not consider this alternative in any detail, as it could not fulfill the objective of improving the effectiveness and efficiency of District monitoring activities.

IV.B.2. Data Management

Environmental monitoring at the District is managed and conducted within the program or project for which the environmental monitoring activity is required. Organizing environmental monitoring under projects has evolved because the District has historically organized capital improvement and maintenance activities by project, and because specific monitoring requirements are imposed by regulators on a project-by-project basis as a part of the permitting process. The project-based organizational structure for environmental monitoring is expected to continue.

One result of this project-based structure is the inability of staff to easily access information about the many environmental monitoring activities currently being conducted. Many of the District's managers and technical staff have commented on this limitation. While some projects have sophisticated environmental monitoring data management systems, most do not. Although the District has good examples of well-planned monitoring databases, there is little consistency among projects as to how data management is handled.

Additionally, the way in which monitoring data is currently managed does not easily allow for analysis and decision-making at the watershed scale.

Improving environmental data management will not only support effective project and District management, but will also help improve external communication with regulators and the stakeholder community. The District's ability to demonstrate environmental compliance will be enhanced. Watershed-level stewardship, which requires sharing of information between projects, will also be supported.

There are two general approaches the District could take to better manage environmental data (Figure IV-4). The first is to develop a District-wide database system to store all environmental monitoring data, such as that developed for maintenance data (Computerized Maintenance Management System, or CMMS). Data integrity, input and read-only quality control measures, consistency in database structure and report design, and other improvements could then be more easily addressed District-wide. Unfortunately, implementation of such improvements has many pit falls in practice. Monitoring activities on different programs/projects result from different regulatory drivers and often require different methodologies and different types of data to be gathered and analyzed. Because the data should ultimately drive the system, developing a single over-arching system that would encompass a wide range of existing data types and forecast future needs will be difficult. A system that addresses all of the various environmental monitoring data management needs would be very costly to develop, would take years to implement, and would require significant resources to maintain. Consistency and accuracy in this comprehensive data management system would require additional bureaucracy and overhead, and would likely require District staff devoted solely to its maintenance. This approach provides no improvements in interim data management.

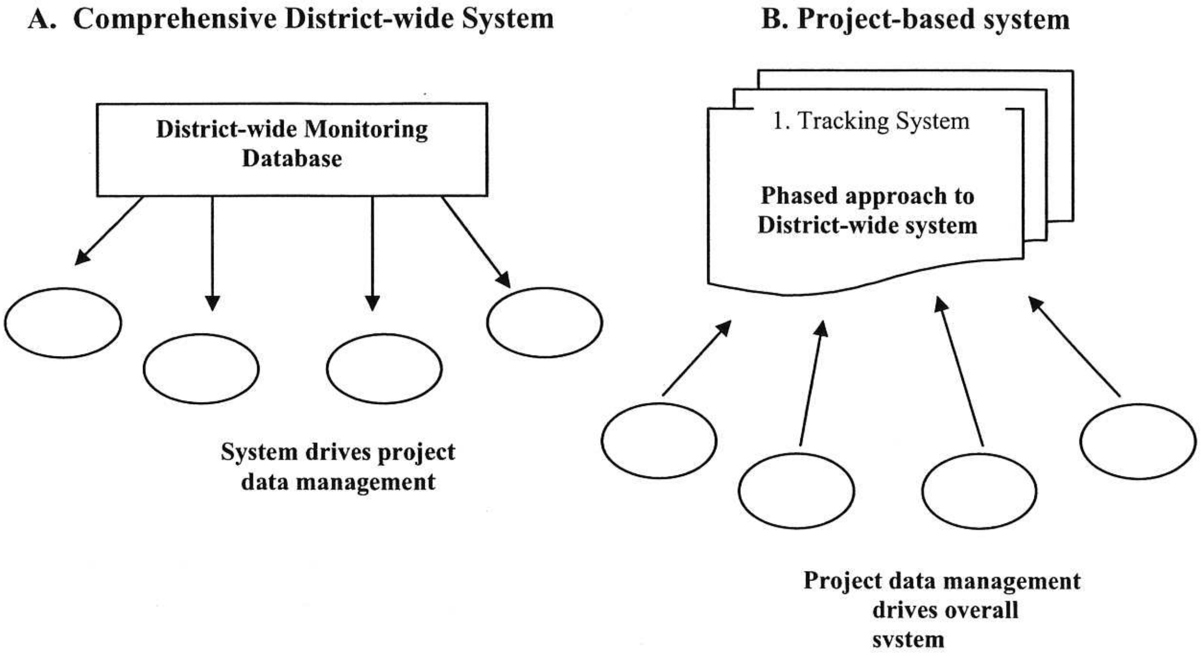

A. Comprehensive District-wide System
B. Project-based system
District-wide Monitoring Database
1. Tracking System
Phased approach to District-wide system
System drives project data management
Project data management drives overall svstem

Figure IV - 4: Two approached to improved environmental data management

Instead of a comprehensive top down approach to environmental monitoring data management, the District should strive to implement a phased approach that builds toward a comprehensive system by ensuring that good data management starts at the project level. Recognizing that projects are largely unique, the District should establish guidelines for data management systems based on existing examples. These guidelines would then be applied as each new environmental monitoring project comes on line. The monitoring database systems wouldn't have to be identical, they would simply have to follow certain guidelines. A comprehensive data management system could then be phased in over time, as necessary.

The need for improvement and consistency in data management at the project level is distinct from District management's need to keep track of all environmental monitoring projects. Here, an interim system can be developed and implemented at a relatively low cost and in a relatively short time frame that would substantially meet the District's current needs. Rather than a complete data management system in itself, the tracking system merely identifies where environmental monitoring is occurring, and references how to get to the data when necessary. With the environmental monitoring tracking system, District management will have a comprehensive list of all environmental monitoring activities, and will be able to project future costs, as well as identify potential efficiencies where overlapping monitoring is being conducted. The tracking system could also be used to steer internal and external environmental scientists, regulators, or stakeholders toward other data that they might find useful.

This section outlines a conceptual framework for addressing data management at both levels, including a discussion of the purpose, benefits, and potential implementation strategies for developing a management-level tracking system and project-level database structure.

IV.B.2.a. Management needs vs. project-level needs

Currently, no means exist to generate or track a comprehensive list of all environmental monitoring activities. Many District staff have noted this deficiency. Data that have resulted from monitoring activities are stored and maintained project by project on different servers among the responsible departments/divisions within the District. The stored data include a diverse set of variables related to physical, biological, or water quality information. Much of these data are collected over multiple years. The data format typically varies depending on the software application (database) used for managing and retrieving data. District management has no means of forecasting and controlling monitoring costs, or of promoting efficiency in environmental monitoring.

Box 1. Potential Benefits of an Environmental Monitoring

Tracking System

- ☐ Facilitate planning of monitoring efforts in a way that is consistent with the District's watershed stewardship objectives
- ☐ Help avoid duplication of effort
- ☐ Provide information for budget planning purposes
- ☐ Help evaluate staff and resource allocation needs
- ☐ Maximize the usefulness of collected data
- ☐ Facilitate a movement toward data standardization and permit tracking
- ☐ Provide information to regulators and/or the public on current monitoring efforts
- ☐ Help streamline the permitting process
- ☐ Assist in documentation of regulatory compliance

Because monitoring activities are driven by regulatory requirements, monitoring data are analyzed and reported based on project-specific needs. This project-level linkage will likely continue, and data management at the project-level must meet project-specific needs.

Management needs
Development of a system to keep track of environmental monitoring activities throughout the District is a central element in improving monitoring program effectiveness and efficiency in the near-term. An environmental monitoring tracking system would promote District-wide communication and access to monitoring information while project-level data management is being improved. Such a management tool has the potential for numerous benefits, summarized in Box 1 and discussed below.

Tracking System
Such a system would be used to allow managers to identify and track current monitoring activities, including such things as a description of the type of activity, the site location (e.g. watershed) and schedule. This would facilitate planning of monitoring efforts in a way that is consistent with the District's overall watershed stewardship objectives and could be used to provide information to regulators and/or the public on current monitoring efforts.

The system would assist in identifying existing or potential overlap of monitoring to help avoid duplication of efforts, and would describe the data format and database it is stored in. This would be critical for improving the efficiency of data collection and implementation efforts (e.g.

identifying timing and staffing needs of projects requiring similar monitoring activities) and facilitating the movement toward data standardization (e.g. collection of specific data types in a consistent format to facilitate data comparison and analysis).

By describing where various monitoring data exists, access to project-specific data increases, and that data may be used by District staff in additional analyses or within the larger watershed context. It could also facilitate data sharing among the public, scientific and regulatory community. An additional benefit of the system would be to track any agency specific permits required for the various monitoring projects, in order to identify areas of overlap where the permitting process might be streamlined in the future and to assist in the documentation of regulatory compliance. All of these benefits are consistent with the District's new objectives of watershed stewardship.

In order for such a system to be effective, it would need to include and track all monitoring activities and contain certain minimum components. It does not need to be overly complex and should be relatively simple to use and maintain. The tracking system would not house the collected environmental monitoring data itself, this would be stored in project specific databases (discussed in Section 12.1.2), but would instead, at a minimum, reference the associated program/project, the type of monitoring activity, and information specific to the data being collected, such as which Department or Division controls the data, the data management system used, where the data is stored and maintained, its format, and responsible project manager or group.

The details regarding implementation of information systems to fully develop these concepts will be dependent on the coordination and communication of District Information Systems personnel and Project Managers. Additionally, the District should consider how environmental monitoring data management would be incorporated within the District's overall data management structure.

Incorporating Environmental Monitoring Tracking System Into Existing Systems
A review of various documents was made in an effort to help identify ways for improving the effectiveness and efficiency of environmental monitoring data storage and management over all projects and programs throughout the District. The documents reviewed were supplied by the District as relevant to past, current, and future projects and are representative of the District's need to compile, store, and retrieve monitoring information about each project regardless of project type or the Division under which the project is managed. The documents included; the Santa Clara Valley Water District Information Systems Master Plan (February 2001), the Clean, Safe Creeks and Natural Flood Protection Implementation Plan (June 2001), the Draft Implementation Plan for the Guadalupe River Mitigation and Monitoring Plan (February 2002), and the Draft Stream Maintenance Program (March 2001).\

Information Systems Master Plan

With the adoption of the Information Systems Master Plan (ISMP), the District has outlined a new approach to managing all information from projects through the use of core enterprise information systems. Any data management system developed for tracking of monitoring activities should be integrated into the larger District-wide data management structure outlined in the ISMP. The ISMP describes the seven core systems currently in use, identifies their limitations and documents conceptual design changes required to meet the District's goals of improving each system.

The seven core information systems are

- Financial Management (FMS)

- Human Resources and Payroll (HR)
- Water Resources Information System (WRIS)
- Electronic Document Management System (EDMS)
- Computerized Maintenance Management System (CMMS)
- Geographic Information System (GIS)
- Supervisory control and Data Acquisition System (SCADA)

The ISMP provides a comprehensive review for each of these systems and outlines specific recommendations for each system including improving integration with other systems and replacement of out dated operating platforms. These reviews and conceptual design changes demonstrate the commitment of the District to improve all of the information systems in use on a district-wide basis.

The ISMP calls for the creation of an Information Management Program Office (IMPO) to facilitate changes to the core systems. The ISMP outlines how core systems relate to each other and diagrams how members of the Implementation Project Team interact through the Information Management Program Unit (IMPU) and communicate with the Information Technical Advisory Committee (ITAC) to bring about developmental changes.

As many of these developmental changes are new to the District, it has yet to be determined how functional they will be. However, the limitations of the existing systems have been well documented along with the District's End Policies and Performance Measures. Together these form a solid basis for developmental change. As is correctly stated within ISMP, any beneficial change brought about by gains in information technology is dependent on effective and efficient work practices. The improvement of work practices remains within each Unit, Section, and Division with the District at the project level.

Tracking System Recommendations
In the past, data associated with any given project was managed within a Department or Division and information regarding that project was difficult to convey to other groups within the District. Many of the core systems are projected to be upgraded or replaced to allow for information to be available on an enterprise level (District-wide). The integration of the core systems with individual databases will result in a more standardized data format and will allow for information to be shared more easily within the District. A tracking system for environmental monitoring activities should interface with, or possibly be incorporated within, one of these existing core systems.

There are three candidate core systems that provide the structure and breadth necessary to meet the needs of such a tracking system. They are:
1. Computerized Maintenance Management System (CMMS)
2. Geographic Information System (GIS)
3. Electronic Document Management System (EDMS)

The core CMMS provides for project tracking of ongoing maintenance using the MAXIMO database. The MAXIMO database provides the best existing core system to accommodate an environmental monitoring tracking system. It provides information at the project and activity level, functions District-wide, and utilizes a "best of breed" platform described in the ISMP as "a robust platform with functionality that far exceeds the District's requirements" that is currently being under utilized.

One of the common threads throughout the core information systems used by the District is the utilization of GIS. The GIS is planned to interface with all of the District's core systems, therefore, a coverage layer depicting existing and anticipated monitoring activity and associated attributes would be able to be shared throughout the District. The GIS currently in use at the District (ESRI ArcInfo/ArcView) is considered a "best of breed" system, a proven and reliable application software, and is identified as being a critical system to support the District's future information needs. Many of the core systems already integrate with GIS. This allows for the potential to increase the use of GIS to accommodate sharing of information among projects and may provide a way for monitoring data to be tracked and integrated into the District-wide data management structure as proposed in the ISMP.

Box 2. Benefits of a clear and comprehensive project-level database design

The project is:

- ☐ well thought out
- ☐ organized

Data are:

- ☐ functional and accessible
- ☐ efficiently used and maintained
- ☐ verified, accurate, and secure

The EDMS is described as an out-dated system that was never fully functional. It ties more with the financial and human resources systems. However, the system is currently utilized District-wide and is projected for major revision, including elimination of the current HP operating platform in favor of an Oracle based platform. As this design and development of this system takes place, the opportunity exists for District managers and IT personnel to work together and utilize the system for tracking of environmental monitoring activities.

Once an appropriate core system is identified to accommodate the need for tracking of environmental monitoring, it can then be used in conjunction with anticipated monitoring as defined in upcoming projects to allow managers to utilize data associated with other projects and gain efficiencies. This presents an opportunity for project managers and IT personnel to meet the challenge of developing a system to accommodate these needs.

Project-level needs for management of monitoring data

A framework for developing project specific data collection and storage systems for environmental monitoring activities should be implemented. Clear and comprehensive design protocol for data collection and storage will benefit the District in many ways.

The process of designing an appropriate database promotes organization and project planning by requiring that the project be well thought out. The purpose and use of the database must be clearly defined, and data collection, analysis, and reporting should be considered in depth. These planning exercises will make the implementation process more effective and efficient.

In addition, by carefully considering the requirements for each project-specific database, existing databases may be utilized or modified as necessary, or new databases designed that can accommodate various project needs. Similar activities should use similar database design. This allows for data collected by any given monitoring activity to be more closely associated with the same monitoring activity from another project. Ultimately, it may allow for different projects to collect and store similar monitoring data in the same format.

However, the data should drive the database design, rather than attempting to force data into an existing structure that may not be suitable for the project specific needs. Part of the original database design considerations should include the ability to easily modify the database to meet the needs of other projects. Another benefit to careful database design is the development of quality assurance/quality control procedures, which promotes data accuracy and consistency.

Finally, database design should also address security concerns.

A key element in developing a design for monitoring projects is to ensure that the basic structure of the data being collected is sound and that it follows the fundamental principles for relational database design. These principles include:

- A clearly defined set of variables with associated attributes and metadata that utilize standard naming conventions
- Established relationships between data entities
- Normalization of data (to minimize or eliminate redundancy)
- Tables with defined data records and key fields

In addition, the data storage system should provide a clear concept of the hardware and software requirements. Hardware needs to be compatible for use within the District network environment. Application software should be standardized as much as possible and relational database software should be Open DataBase Connectivity (ODBC) compliant to allow for maximum access to data. The system should address the quality assurance (QA) procedures for collecting, storing, and verification of all data.

Recent District Programs with Monitoring Data Management Needs:

The Clean, Safe Creeks and Natural Flood Protection Implementation Plan and the Draft Implementation Plan for the Guadalupe River Mitigation and Monitoring Plan are both representative of recent programs within the District. Both plans have long-term maintenance and environmental monitoring needs and both will include multiple projects.

The Guadalupe River Mitigation and Monitoring Plan is a good example of how data should be managed for a long-term monitoring project. The Guadalupe River plan describes a very specific data management strategy for meeting the needs of the project, including development of an integrated environmental information system for data storage, the Guadalupe Environmental Monitoring System (GEMS). The key component of the system is a relational database management system that links to secondary components such as a GIS database, stream temperature model (JSATEMP), and digital images. The data management portion of the Guadalupe River plan defines the necessary system requirements, staff qualifications for data entry, management, and administration, and describes the design of the GEMS system in detail. The process of clearly defining project-level database structure and function, and linking the project-specific database to an appropriate core system (in this case, GIS), should be undertaken by all projects with a major environmental monitoring component.

The Clean, Safe Creeks plan identifies the Watershed Management Division as having primary responsibility for implementation of the plan and the Office of Performance Measurement for developing and maintaining an electronic data management system. No specific data collection or database structure is included in the plan. Other programs, such as the Draft Stream

Maintenance Program, include data collection and storage requirements on a long term basis and utilize existing database structures within the core CMMS.

How these programs and others function within the ISMP framework to fully integrate data and project information has not been fully developed by the District. Interaction and involvement of the ITAC through the relationships outlined in the ISMP and utilization of system improvements documented in the ISMP will provide the basis for improved effectiveness and efficiency of data storage.

IV.B.2.b. Facilitating Public Access to Data

With a tracking database system that has been fully developed and implemented, data collected from monitoring projects could be directly accessed from links within the system. The tracking database would show which projects support which monitoring activities and users could select projects with compatible databases to view standardized data reports or choose from a set of selected variables to query the database. This concept leads to a data warehousing approach that has the advantage of providing more access to data, but that would also require more stringent security measures, especially if made available as part of a web-based application.

The amount and content of data currently made available to the public by the District is uncertain. None of the core systems currently provide for public access to data, and much of the information available through these systems for any given project is primarily for management purposes and not necessarily useful for the public.

Public access to information would likely be made available through the internet and would require integration of web-based information with the core database system. Provisions for this procedure are described in the ISMP and would involve coordination between District staff from the department responsible for maintaining the database and the ITAC. Following these procedure would provide for a complete review of the data to ensure the intention, obligation, and content prior to being made available to the public.

Development of a tracking system and incorporation of database design at the project level will provide the necessary foundation from which to build public access into the system.

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V. CONCLUSIONS

V.A. Characteristics and Trends of Environmental Monitoring by the District

The District Board ends policies prescribe a balance between flood management and stewardship of natural resources. The ends policies also require a means to measure progress toward these goals.

The District undertakes environmental monitoring projects in accordance with negotiated regulatory and legal agreements that allow the District to construct, operate, and maintain flood management projects. The District also helps finance and participates in management of collaborative monitoring with other agencies in the San Francisco Bay Region. This monitoring is also required for compliance with regulations.

Based on current trends and practices, spending projections confirm a forthcoming massive increase in monitoring commitments, driven by the multi-year Stream Maintenance Program, the Fisheries and Aquatic Habitat Collaborative Effort, implementation of the District's capital program, and other regulatory and programmatic commitments

We also project that the District will receive a number of requests for water quality sampling and studies that will assist Regional Board staff to estimate watershed loadings for various pollutants. The District will also be requested to assist the Regional Board by providing more thorough characterizations of water quality and how it may affect aquatic life in streams and wetlands within the District's jurisdiction and to participate in regional resource assessment efforts related to HCPs and other regulatory drivers.

V.B. Assessment of Factors Affecting Efficiency and Effectiveness of Environmental Monitoring

The District's existing and projected monitoring activities serve regulatory requirements, but are not designed to characterize the stream functions (e.g. movement of water and sediment) that support aquatic life, nor to measure the status of aquatic life throughout the length of the stream.

Data collected through these activities is of the type and extent that would be useful to a comprehensive watershed assessment; however, the project-specific data is not routinely compiled or analyzed for information on watershed status. Nor is the data routinely examined for information on how the monitoring results might apply to other projects or issues that the District is pursuing.

District staff perceives serious shortcomings and problems related to the District's environmental monitoring activities: that the overall effort is fragmented and reactive, that the results of monitoring are not often used in decision-making, and that there is a lack of consistency in quality assurance, recording of metadata, and reporting. Participants in a structured discussion also felt that the District doesn't use the knowledge obtained from monitoring to leverage better deals when negotiating with regulatory agencies. A third area of concern is difficulties in leading and organizing staff engaged in environmental monitoring activities, because of a lack of vision and stated priorities.

We concluded that the basic underlying condition limiting the efficiency and effectiveness of the District's environmental monitoring activities was that environmental monitoring (and other environmental services, such as planning) -- having been fashioned to serve the needs of specific projects

-- are now being redirected to serve the District's new watershed management mandate. The District organizational structure and way of doing business lags behind the policy change, and this is the root source of many, if not most, of the identified shortcomings in the District's monitoring activities.

New management objectives and new management strategies must be supported by new ways of collecting, interpreting, and presenting information. The District has long been able to monitor and analyze rainfall, runoff, and stream flow throughout the watershed. These capabilities are needed to support the design, operation, and maintenance of dams and flood control channels.

Now, the District must develop the capability to monitor and analyze stream habitat, riparian corridors, and natural resources, so that it can design, operate, and maintain its facilities to meet new objectives.

At the same time, the District needs to maintain and improve its ability to efficiently implement the monitoring requirements imposed by regulatory agencies. Although the Clean Safe Creeks and Natural Flood Protection ballot initiative authorized funding for monitoring and water-quality assessment (specifically related to TMDLs), and additional funding may be available to support comprehensive watershed monitoring, much of the District's future environmental monitoring activities will, as in the past, be in response to regulatory requirements of project permits, EIRs, and the settlement of lawsuits and regulatory actions.

Further, while facilitating the transition to watershed management, the District should seek to retain the benefits of its project-by-project focus at the same time that it seeks to overcome the limitations of this approach. The District's environmental monitoring staff must continue to effectively implement the monitoring requirements associated with individual projects – including, for example, baseline surveys and consultation with project managers – while also providing the information that will assist District executives and the Board to make watershed management decisions.

V.C. Best Course of Action to Improve Effectiveness and Efficiency of Environmental Monitoring

We conclude that the best alternative available to the District is to organize and coordinate District monitoring activities to serve the needs of watershed management, while enhancing service to individual projects.

The organization and coordination of District monitoring activities will require a set of management controls and practices that will insure that, over time, ongoing and new monitoring activities serve both individual project needs and comprehensive watershed stewardship effectively and efficiently.

VI. RECOMMENDATIONS

We recommend a 3-part strategy to organize and coordinate District monitoring activities to serve the needs of watershed management, while enhancing service to individual projects. By implementing this strategy the District will, over time, gain greater management control over its monitoring activities and be better able to use monitoring data in decision-making. This should enable the District to save costs and better serve the community.

1. **Enhance the District's ability to use monitoring information in watershed management.** The District should develop a system for synthesizing, interpreting, and reporting environmental monitoring data. The focal point of such a system could be an annual report on the status of the watershed and the District's stewardship efforts. The District should develop a process for routinely organizing environmental data into indicators. The indicators, placed in proper context, create the basis for a compelling story about the watershed, its habitats, the multiple functions of its streams, and the District's work to maintain and improve it. This narrative provides the basis for both management decision-making and public involvement in, and support for, the District's work.

2. **Make Project-Specific Monitoring Plans More Efficient and Effective.** To overcome the project-specific compartmentalization of monitoring activities, and the resulting inconsistency in quality and methods, the District should establish a centralized and uniform quality assurance/quality control (QA/QC) process for monitoring projects. This QA/QC should focus on the planning stages of monitoring projects. In particular, new monitoring plans should undergo a formalized data quality objectives (DQO) process, adapted from that developed by USEPA. By implementing a consistent set of QA/QC requirements, including requirements for the preparation of project reports, the District will facilitate compilation and analysis of data across projects. This will, in time, enable the District to make better use of the data and to better target future monitoring efforts.

   The District should also improve collaborative relationships between staff responsible for implementing projects (on the one hand) and the scientists and environmental policy experts responsible for preparing environmental documentation, obtaining permits, and implementing monitoring and mitigation plans (on the other). Some structural and process changes will be needed to successfully balance project-specific focus (on obtaining permits and approvals) with the District's longer-term watershed stewardship objectives.

3. **Insure that Future Monitoring Commitments Are Part of a Coordinated Strategy that Includes Regulatory Compliance.** As the business of managing the watershed gets ever more complex (with more players and more policy issues to consider at every step), the District needs to better coordinate its environmental planning and regulatory compliance activities and adopt a forward-thinking, strategic view. That strategic view should influence what data is to be collected, how and where it is collected, and how and where it is reported. Staff responsible for the overall monitoring program should be involved whenever environmental mitigation or monitoring is discussed in connection with project-specific permits, legal considerations or regulatory issues.

   To enable staff to track and coordinate monitoring activities, the District needs to develop better data management structures and procedures. As an initial step, which may prove adequate to this need, the District should establish a tracking database to (1) facilitate access to monitoring data and (2) enable staff to track the status of monitoring projects and insure that they are complying with District procedures and QA/QC requirements.

Implementation of these three strategies will be stepwise, and the results will be seen incrementally, rather than as a single major improvement. This approach is dictated by the complexity of the District's organization and the multiple objectives that are served by monitoring activities.

Detailed recommendations follow. To facilitate review and implementation, the recommendations are organized into tasks and presented in an outline format.

I. Enhance the District's Ability to Use Monitoring Information in Watershed Management

Improving the efficiency and effectiveness of the District's monitoring depends, first and foremost, on successfully linking monitoring information to management decision-making. The following tasks and subtasks focus on establishing a system that will allow management to use monitoring results to make better management decisions.

Consistent with the recommendations of the National Research Council (NRC 1991), the District should focus its efforts on up-front program design and the "synthesis, interpretation, and reporting" of monitoring information. This "synthesis, interpretation, and reporting" should use a system of indicators. Steps to developing those indicators are:

- Draft a "story" (i.e., a problem statement) that posits an environmental problem to be investigated or solved,
- Create a framework (e.g., a conceptual model) that provides structure for the various elements of the story, and
- Identify indicators that will consistently contribute to the narrative.

I.A. Facilitate Consensus on Monitoring Objectives

The problem statements, conceptual models, and indicators should be developed in a collaborative process that brings together management concerns, technical expertise, and stakeholder input.

I.A.1. Communicate improvement objectives and plans to management and staff.

The MAEP showed that management and staff at various levels, and in various departments, feel they have a stake in improving the District's environmental monitoring. To successfully implement the proposed improvements, it is essential that they "buy-in" to the recommended strategy. The purpose of the following subtasks is to obtain feedback and refine the recommended strategy as needed to win enthusiastic support for the strategy.

I.A.1.a. *Present the MAER to District managers and staff in focused meetings.*

I.A.1.b. *Prepare and distribute periodic updates on MAEP implementation.*

I.A.2. Develop and implement a collaborative process for involving external stakeholders in determining monitoring objectives.

Various external parties are interested in the District's future monitoring plans. These include regulatory agencies, environmental advocates, other agencies subject to the same regulations, and members of the public.

The Santa Clara Basin Watershed Management Initiative is a suitable venue for engaging these stakeholders in discussions of the District's future monitoring plans. The following subtasks are designed to engage stakeholders in an organized and productive way. The outcome should be stakeholder acceptance of and support for the District's plans to improve its environmental monitoring activities.

I.A.2.a. *Present the MAER to the WMI.*
This would take the form of a short presentation at a WMI Core Group meeting (possibly as a lunchtime "brown bag.")

I.A.2.b. *Develop a short-term issue proposal for WMI.*
This is a format the WMI has adopted for stakeholders to introduce specific issues they would like the WMI to address.

I.A.2.c. *Recruit and establish a WMI Work Group.*
WMI Work Groups are informal. For this project, the District should seek to involve regulatory agency staff, key environmental advocates, and technical staff from other public agencies, as well as other interested WMI stakeholders.

I.A.2.d. *Establish a schedule and process for review and interaction.*
The District should provide facilitation and leadership for the Work Group.

I.A.2.e. *Summarize WMI Work Group process and inputs to monitoring objectives.*
The Work Group's input should be carefully documented and included in the documentation of how problem statements, conceptual models, and indicators were developed.

I.B. Create a District Process to Synthesize, Interpret and Report Monitoring Data

Following are the detailed tasks that should be implemented to develop an indicator-based system to synthesize, interpret and report monitoring data so that it may be used in management decision-making.

I.B.1. Develop problem statements, conceptual models, and management questions.

Selecting a set of indicators can seem tantamount to establishing management objectives. A structured approach, implemented by a focused, multi-disciplinary work group, can keep the process focused and on-schedule.

I.B.1.a. *Assemble a staff work group of watershed managers and scientists.*
The staff work group should be small, but should represent all actors in the monitoring process and include a cross-section of management and technical expertise.

I.B.1.b. *Draft detailed conceptual model diagrams and problem statements.*
The "problem statements" should encompass both technical and policy issues, the historical development of existing conditions, and the prospects and obstacles for achieving improvements.

I.B.1.c. *Review conceptual models and problem statements and identify preliminary management questions.*
The staff work group should work with management to identify which links within each conceptual model should be targeted for management intervention.

I.B.1.d. *Solicit external review of conceptual models and problem statements.*
The staff work group should obtain input from WMI Work Group, RMP Work Groups, Regional Board staff, others. The RMP Work

Groups, and Regional Board staff involved in TMDLs, have experience with developing and applying conceptual models.

I.B.1.e. *Refine conceptual models, problem statements, and management questions; develop consensus.*

The staff work group should "close the loop" and insure that internal and external stakeholders understand and support the District's approach.

I.B.2. Develop a preliminary set of indicators.

I.B.2.a. *Review management questions and available data.*

I.B.2.b. *Develop criteria for selecting indicators.*

Criteria may include the availability of suitable data, relevance of the indicator over the long term, and transparency (i.e., how easy is it to understand what is being measured and why).

I.B.2.c. *Hold staff work group session to identify candidate indicators.*

I.B.2.d. *Research suitability and practicality of candidate indicators.*

I.B.2.e. *Propose a suite of indicators.*

I.B.2.f. *Review indicators suite with work group and refine.*

I.B.3. Assess which indicators are supported by current monitoring commitments or data from regional programs and other external sources.

I.B.4. Identify additional monitoring required to support indicators and initiate monitoring projects.

I.B.5. Develop and implement a process for indicator-based annual reporting of the status of District watersheds.

I.B.5.a. *Select appropriate annual cycle (CY, FY, or WY) and set target date for initial report (consider that this should be tied to budget process).*

I.B.5.b. *Develop concept, draft contents, outline for initial report and later reports.*

I.B.5.c. *Review concept, contents, outline with staff Work Group and WMI Work Group.*

I.B.5.d. *Prepare first report using indicators supported by available data.*

I.B.6. Present process to District management.

II. Make Project-Specific Monitoring Plans More Efficient and Effective

The District is implementing many mitigation and monitoring plans; many of these are state-of-the-art. However, because of a lack of coordination and overall planning, their cost and expense is higher than necessary, and the overall value of their results to the District is reduced.

By implementing the following tasks, the District will create internal systems to review, track, and control monitoring projects. The system will be created over time, and will become more effective as monitoring projects move through the queue (i.e. as current projects are completed and more of the new projects have the benefit of this review, tracking, and control).

II.A. Implement a Uniform Quality Assurance Process for Monitoring Projects

A uniform QA process will provide a structure and mechanism for reviewing, tracking and controlling monitoring projects. At the same time, it will make individual projects more efficient and effective. Projects will be systematically reviewed to insure that data collection is carefully targeted to hypothesis testing.

II.A.1. Develop format and requirements for preliminary project plans.

This will be the first step toward maintaining a suitable monitoring project tracking system. New monitoring activity will be documented as it is initiated so that the activity can be tracked. Minimum requirements for preliminary project plans should include project purpose, scope, schedule, and budget.

II.A.2. Establish a Data Quality Objectives (DQO) process.

II.A.3. Adapt USEPA requirements to be suitable to the types of monitoring done by the District and to the District's organizational structure.

The District should implement a project to involve a work group of selected staff (with possible participation of outside consultants or volunteers) in reviewing USEPA's Guidance for the Data Quality Objectives Process (EPA QA/G-4) and other EPA Quality System series documents. The work group should develop a DQO process or similar structural, systematic planning process for District monitoring projects. It may be useful to examine the DQO process used by the Regional Monitoring Program for Trace Substances. The work group should include scientists experienced with planning and implementing quality assurance for projects that include biological and physical monitoring.

II.A.3.a. Diagram workflow.

One outcome of developing a DQO or similar process should be to implement a set of controls to insure that the process is consistently implemented before any field samples are collected. These controls may include work-flow diagrams or a system of sign-offs to insure compliance.

II.A.3.b. Assign staff and develop staff capabilities.

Successful implementation of uniform QA will depend on building staff expertise in practical application of the scientific method, including the preparation of problem statements, statement of hypotheses, and statistical design. It may be useful to develop a curriculum and set of references.

II.A.4. Develop requirements for Quality Assurance Project Plans.

II.A.4.a. Adapt USEPA requirements, using examples of QAPPs used by the District and by associated regional entities.

The outcome of this task should be a document describing QAPP requirements, with reference to a set of appropriate examples.

II.A.4.b. Assign staff responsibilities for review of QAPPs.

II.A.5. Develop standards for delivery of data and metadata.

II.A.5.a. Data standards.

QAPPs should include specific descriptions of how data will be managed for the project. A single database design that would accommodate data from all monitoring projects is infeasible; however, each project should have a data management plan. For the simplest projects, a flat-file database or spreadsheet may be sufficient. QAPPs for more complex projects should demonstrate use of fundamental principles of sound relational database design.

II.A.5.b. *Metadata standards.*

Recommendation III.B. includes development of a tracking database for monitoring projects. To support this tracking database, individual projects will need to report the characteristics of the data collected (metadata) in a uniform format.

II.A.5.c. *Assign staff to implement and enforce data and metadata standards.*

II.A.6. Develop and implement standards for preparation, publication, and dissemination of monitoring reports.

To make use of the results of District monitoring projects, District staff and others must have access to complete, well-documented reports that include project objectives, methods used, results obtained, discussion of results, and conclusions. Reports should also include an abstract.

Reports should be published in both hard-copy and electronic format. Abstracts, full reports, and data should be accessible (with appropriate permissions, if necessary) via the District's web site or internet ftp site.

II.A.7. Develop and implement a process for peer review and public review of District monitoring projects.

II.A.7.a. *Peer review.*

The District should cultivate formal and informal partnerships for collaboration and review of technical reports. Potential partners include SCVURPPP, the RMP, staff at the Regional Board, USGS, and EPA, and academic researchers from UCSC, Stanford University, SJSU, and UC-Berkeley.

II.A.7.b. *Public Review.*

The District should establish a subscriber email list for interested parties who may wish to be informed of opportunities to review monitoring reports.

II.A.7.c. *Assign staff to oversee this process.*

The above subtasks require assignment of qualified staff who are able to represent the District on regulatory as well as technical matters.

II.B. Develop And Implement A Process To Facilitate Communication And Collaboration Between Project Managers And Staff Scientists.

District Project Managers are focused on obtaining regulatory approvals or settlements quickly so that capital projects, operations, and maintenance can proceed. District scientists, by assignment and training, are focused on providing accurate and defensible scientific and technical analysis. Project managers and scientists should help prepare scopes for specific monitoring projects, but qualified staff whose primary assignment is to integrate the District's monitoring efforts into a unified, efficient, and effective program should mediate the process.

II.B.1. Develop procedures to facilitate collaboration when monitoring projects are initiated.

This process should include establishment of a workgroup including project management, scientific staff, and staff responsible for oversight of the District's monitoring program.

II.B.2. Develop protocols for project managers to incorporate ecological services into project budgets and incorporate these protocols in Engineering Policies and Procedures.

II.B.2.a. *Budget protocols.*
Staff should develop a budgeting process for the use of ecological services (including management of mitigation and monitoring plans and field surveys and consultations).

II.B.2.b. *Approval process.*
Before project budgets are approved, staff responsible for oversight of the monitoring program should sign-off on budget estimates for ecological services.

II.B.3. Develop and implement a system for tracking monitoring commitments and staff hours required to fulfill commitments.

Use of consistent and accurate budget projections for monitoring services (Task II.B.2.) will facilitate accurate forecasts of demand. Staff should also develop procedures for prioritizing and scheduling monitoring services in light of increasing number of projects and overall demand.

Staff responsible for oversight of the monitoring program should be empowered to make decisions regarding the use of staff vs. temporary staff or consultant resources to fulfill monitoring requirements for projects.

II.B.4. Develop and implement a system for tracking hours expended on, and data obtained from, "ad-hoc" surveys and monitoring.

To accurately forecast overall demand on ecological services staff, it will be necessary to anticipate the flow of requests for field inspections and assistance. Staff should develop methods and systems for accurately logging and tracking such requests.

III. Insure that Future Monitoring Commitments Are Part of a Coordinated Strategy that Includes Regulatory Compliance

Although most of the District's monitoring activities will continue to be driven by specific projects, the District should, over the next few years, adopt monitoring as a component of an overall coordinated strategy for cost-effective regulatory compliance. This means anticipating regulatory trends and vulnerabilities, examining how an expanded role in watershed management creates new exposures to regulatory noncompliance (and, at the same time, provides opportunities to implement new compliance strategies), and proactively conducting monitoring and technical studies aimed at facilitating future regulatory negotiations. Implementing the subtasks below will help the District incorporate monitoring into such a coordinated strategy.

III.A. Develop and implement procedures to incorporate District monitoring objectives and standards into regulatory negotiations and commitments.

Many current District monitoring activities (e.g., FAHCE, the Stream Maintenance Program) were created in response to legal and regulatory challenges. In future, the District should try to anticipate legal and regulatory issues and proactively initiate investigations and monitoring to provide a better technical basis for negotiating settlements.

III.A.1. Assign staff responsible for coordination and oversight of the monitoring program to participate in discussions of regulatory or legal settlements that may involve monitoring.

This is required for two reasons: First, to insure that the agreed-to monitoring is coordinated and integrated with existing monitoring efforts, and second, to insure that ongoing design of the overall monitoring program incorporates the information and opinions that are expressed during these discussions. The monitoring program must become "part of the loop" that includes management and regulatory/legal strategy.

III.A.2. Enhance and coordinate District participation in regional monitoring collaboratives (SCBWMI, SCVURPPP, BASMAA, RMP, SFC JPA).

Often, concern over particular pollutants or new regulatory initiatives first surfaces in technical work groups or committees. The District may not always be able to react timely because the relevant information (which may even occur in an informal, off-agenda discussion) is not communicated to all District staff that may be involved with the issue. This may be because the appropriate staff was not present, or because the information didn't get reviewed and communicated to the right person at the right time.

III.A.2.a. *Review staff participation in the steering committees, technical advisory committees, ad-hoc work groups, etc., for these entities.*

III.A.2.b. *Update and add to staff assignments as needed.*

III.A.2.c. *Establish procedures for timely communication of developments (e.g. periodic summary reports of major issues).*

Although this can be addressed by a "system" to distribute meeting summaries, this will not substitute for assigning qualified staff to systematically review the available information and forward it to the attention of the appropriate District staff.

III.A.2.d. *Incorporate relevant information into annual reports on status of District watersheds.*

An annual report would be a suitable place to integrate District-generated monitoring information with that from other efforts throughout the region to produce an overall snapshot of how the watershed is faring. Preparation of these reports would also facilitate incorporation of the results of external monitoring programs into the District's future monitoring plans.

III.B. Improve Accessibility and Usability of District Environmental Data.

Data management should be viewed as a means, not an end in itself. Monitoring projects have diverse regulatory and policy drivers and so will require different methodologies and will produce different types of data to be collected and analyzed. To serve individual projects while also facilitating analysis at the watershed scale, data management will need to address both project-specific needs and management-level needs.

To serve both needs, it is recommended to develop a management-level tracking system and project-specific database requirements.

III.B.1. Develop a management-level tracking system.

Development of a system to keep track of environmental monitoring activities throughout the District is a central element in improving monitoring program effectiveness and efficiency. An environmental monitoring tracking system would promote District-wide communication and access to monitoring information.

The tracking system would not house the collected environmental monitoring data itself (this would be stored in project specific databases) but would instead, at a minimum, reference the associated program/project, the type of monitoring activity, information specific to the data being collected, the data management system used, where the data is stored and maintained, its format, and responsible project manager or group.

III.B.1.a. *Select and identify project team.*
This team should include staff from the Watershed Management Division and Information Systems.

III.B.1.b. *Review District data management systems and select a core system to house the tracking system.*
Candidate core systems are: (1) Computerized Maintenance Management System (CMMS); (2) Geographic Information System (GIS); (3) Electronic Document Management System (EDMS).

III.B.1.c. *Design and implement tracking system.*

III.B.2. Develop project-specific database requirements.

III.B.2.a. *Review the Guadalupe River Mitigation and Monitoring Plan database as a suitable exemplar.*

III.B.2.b. *Review data management needs of the Clean, Safe Creeks Plan and the Stream Maintenance Program and coordinate with the integration of these programs into the District Information Systems Management Plan framework.*

III.B.2.c. *Develop and implement project-specific database requirements. Integrate with Tasks II.A.4.a. and II.A.5.*

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Appendix A: Project-specific Information

Project-specific information table from projections database.

Project_name	SCVWD_project_number	Project_Activity_name	Affected_river_miles	Affected_acreage	Start_Fiscal_Year
CIP: Adobe Creek	101005, 101007, 101008, 101009	in-channel construction	5.5		2008
CIP: Adobe Creek	101005, 101007, 101008, 101009	riparian/floodplain construction	5.5		2008
CIP: Matadero/Barron Creeks Remediation	102109	in-channel construction	6		2008
CIP: Matadero/Barron Creeks Remediation	102109	riparian/floodplain construction	6		2008
CIP: San Francisquito Creek Levee Restoration	102806	riparian/floodplain construction	1.7		2003
CIP: Stevens Creek Drop Structure Modifications	102901	in-channel construction	1		2003
CIP: Freshwater Wetlands Maintenance Mitigation	200420	restoration and revegetation		3	2003
CIP: Calabazas Creek Revegetation	201013	restoration and revegetation	2		2004
CIP: Calabazas Creek, Bollinger Bridge Reconstruction	201015	in-channel construction	1		2004
CIP: Calabazas Creek, Bollinger Bridge Reconstruction	201015	riparian/floodplain construction	1		2004
CIP: Calabazas Creek, Bollinger Bridge Reconstruction	201015	restoration and revegetation	1		2004
CIP: San Tomas Creek Repairs	201905	riparian/floodplain construction	4		2007
CIP: Guadalupe River	301511	in-channel construction	6		2008

Project_name	SCVWD_project_number	Project_Activity_name	Affected _river_ miles	Affected_ acreage	Start_ Fiscal_ Year
CIP: Guadalupe River	301511	riparian/floodplain construction	6		2008
CIP: Guadalupe River Downtown	301513, 301514, 301515, 301516, 301517	trail and open space enhancement	2.5		2006
CIP: Guadalupe River Downtown	301513, 301514, 301515, 301516, 301517	riparian/floodplain construction	2.5		2006
CIP: Guadalupe River Downtown	301513, 301514, 301515, 301516, 301517	property acquisition	2.5		2006
CIP: Guadalupe Creek Restoration	301525	in-channel construction	2.3		2002
CIP: Guadalupe Creek Restoration	301525	riparian/floodplain construction	2.3		2002
CIP: Los Gatos Creek Erosion Repairs	302002	riparian/floodplain construction	1		2002
CIP: Los Gatos Creek	302003	riparian/floodplain construction	1		2004
CIP: Berryessa Creek	401704	in-channel construction	1.6		2005
CIP: Berryessa Creek	401704	riparian/floodplain construction	1.6		2005
CIP: Berryessa Creek	401704	trail and open space enhancement	1.6		2005
CIP: Calera Creek	401802	riparian/floodplain construction	1		2002
CIP: Coyote Creek SF Bay to Montague	402108	riparian/floodplain construction	9.1		2003
CIP: Coyote Creek SF Bay to Montague	402108	property acquisition	9.1		2003
CIP: Coyote Creek Outdoor Classroom	402118	riparian/floodplain construction	1		2002
CIP: Coyote Creek Outdoor Classroom	402118	restoration and revegetation	1		2002
CIP: Coyote Creek South Bay Mobile Home Park Floodwall	402119	riparian/floodplain construction	1		2002
CIP: Coyote Creek at Rockspring	402120	riparian/floodplain construction	1		2006

Project_name	SCVWD_project_number	Project_Activity_name	Affected _river_ miles	Affected_ acreage	Start_ Fiscal_ Year
CIP: Lower Silver Creek	402601, 402603, 402607, 402608, 402609	in-channel construction	6		2010
CIP: Lower Silver Creek	402601, 402603, 402607, 402608, 402609	riparian/floodplain construction	6		2010
CIP: Lower Silver Creek	402601, 402603, 402607, 402608, 402609	property acquisition	6		2010
CIP: Silver/Thompson Creeks	402610	riparian/floodplain construction	1.4		2006
CIP: Silver/Thompson Creeks	402610	excavation and sediment removal	1.4		2006
CIP: Upper Penitencia Creek	403203, 403204, 403205	in-channel construction	4.2		2011
CIP: Upper Penitencia Creek	403203, 403204, 403205	riparian/floodplain construction	4.2		2011
CIP: Upper Penitencia Creek	403203, 403204, 403205	property acquisition	4.2		2011
CIP: Upper Penitencia Creek	403203, 403204, 403205	trail and open space enhancement	4.2		2011
CIP: Lower Llagas Creek	502801, 502803	spill response	14.6		2007
CIP: Uvas/Llagas Vegetative Buffer Strips	509001	property acquisition	11.8		2005
CIP: Uvas/Llagas Vegetative Buffer Strips	509001	restoration and revegetation	11.8		2005
CIP: Permanente Creek	26C178	in-channel construction	10		2017
CIP: Permanente Creek	26C178	riparian/floodplain construction	10		2017
CIP: Permanente Creek	26C178	trail and open space enhancement	10		2017
CIP: San Francisquito Creek	26C179	in-channel construction	9		2011
CIP: San Francisquito	26C179	riparian/floodplain construction	9		2011

Project_name	SCVWD_project_number	Project_Activity_name	Affected _river_ miles	Affected_ acreage	Start_ Fiscal_ Year
Creek					
CIP: San Francisquito Creek	26C179	trail and open space enhancement	9		2011
CIP: Sunnyvale East Channel	26C232	in-channel construction	6.5		2017
CIP: Sunnyvale East Channel	26C232	riparian/floodplain construction	6.5		2017
CIP: Sunnyvale West Channel	26C233	in-channel construction	2.5		2016
CIP: Sunnyvale West Channel	26C233	riparian/floodplain construction	2.5		2016
CIP: Calabazas Creek	26C236	in-channel construction	2.8		2016
CIP: Calabazas Creek	26C236	riparian/floodplain construction	2.8		2016
CIP: Guadalupe River Upper	261731, 261732, 261733, 26C340, 26C341, 26C342, 26C343, 26C344, 26C45, 26C46, 26C47, 26C48, 26C49, 26C50, 26C51, 26C52	in-channel construction	7.5		2016
CIP: Guadalupe River Upper	261731, 261732, 261733, 26C340, 26C341, 26C342, 26C343, 26C344, 26C45, 26C46, 26C47, 26C48, 26C49, 26C50, 26C51, 26C52	riparian/floodplain construction	7.5		2016
CIP: Berryessa Creek	261741, 261742	riparian/floodplain construction	5.6		2008
CIP: Berryessa Creek	261741, 261742	restoration and revegetation	5.6		2008
CIP: Berryessa Creek	261741, 261742	in-channel construction	5.6		2008
CIP: Coyote Creek Montague to 280	261743	in-channel construction	6.3		2016
CIP: Coyote Creek Montague to 280	261743	riparian/floodplain construction	6.3		2016
CIP: Upper Llagas Creek	261751, 261752	in-channel construction	11.3		2008
CIP: Upper Llagas Creek	261751, 261752	riparian/floodplain construction	11.3		2008

Appendix B: Project Activity/Monitoring Matrix

Project Activity Lookup

Project_Activity_ID	Project_Activity_name
1	in-channel construction
2	riparian/floodplain construction
3	excavation and sediment removal
4	trail and open space enhancement
5	herbicides and pesticides
6	restoration and revegetation
7	spill response
8	property acquisition
9	flow regulation
10	vegetation management

Monitoring Activity Lookup

Monitoring_Activity_ID	Monitoring_Activity_name
1	dissolved oxygen
2	suspended solids (turbidity/TSS)
3	water temperature
4	toxic constituents
5	nutrients
6	pH
7	riparian vegetation
8	SRA vegetation cover
9	wetlands
10	Threatened and Endangered species
11	hydrology
12	channel erosion/deposition
13	fish
14	fish passage
15	macroinvertebrates
16	exotic species
17	geomorphology

Probability of Monitoring

Probability_code	Monitoring_Probability_description	Monitoring_Probability
1	typically required	1
2	potentially required	0.7
3	uncertain	0.2

Project Activity/Monitoring Matrix

ID	Project_Activity_ID	Monitoring_Activity_ID	Probability_code
1	1	2	1
2	1	3	3
3	1	4	2
4	1	5	1
5	1	8	2
6	1	9	2
7	1	10	1
8	1	11	2
9	1	12	2
10	1	13	2
11	1	14	2
12	1	15	2
13	2	2	2
14	2	3	1
15	2	5	2
16	2	7	1
17	2	8	2
18	2	9	2
19	2	10	1
20	2	11	2
21	3	1	1
22	3	2	1
23	3	4	2
24	3	5	1
25	3	6	1
26	3	8	2
27	3	9	2
28	3	10	1
29	3	11	2
30	3	12	1
31	3	13	2
32	3	15	2
33	4	7	2
34	4	10	1
35	5	4	1
36	5	7	2
37	5	8	3
38	5	10	1
39	5	13	2
40	5	15	2
41	6	2	2

ID	Project_Activity_ID	Monitoring_Activity_ID	Probability_code
42	6	3	2
43	6	7	1
44	6	8	1
45	6	9	1
46	6	10	1
47	6	11	2
48	6	12	2
49	6	14	2
50	7	1	1
51	7	4	1
52	7	6	1
53	7	13	2
54	7	15	2
55	8	10	1
56	9	3	1
57	9	4	3
58	9	7	3
59	9	8	3
60	9	9	3
61	9	10	1
62	9	11	1
63	9	12	2
64	9	14	2
65	10	4	2
66	10	7	1
67	10	8	1
68	10	9	1